A CULTURAL STUDIES ANALYSIS OF LOGO IN EDUCATION

Angelos S. AGALIANOS

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[1] For reasons that I will explain in Chapter Four, the identity of two of my interviewees is not disclosed.

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ABSTRACT

Education does not take place in a vacuum, it is a terrain where conflicting ideologies compete and relations of power are inscribed. Despite, however, the accumulation of studies illustrating the social and political nature of schooling, sociological work concerned with educational computing is in short supply; with few exceptions, sociologists of education have not directly addressed educational computing. The development of IT in education in the last two decades has been largely uncritical and the field has been dominated by technocentric approaches. This thesis is an effort to develop a sociological language for understanding educational computing and suggests that the introduction and use of IT in education should be situated within its social, political and cultural context. Appropriating ideas from the sociology of education, sociology of technology and cultural studies, the thesis uses a *cultural circuit* analysis of Logo programming language as a case-study in the sociology of culture in order to illustrate some of the ways in which the introduction of new technologies in education may interplay with the maintenance and/or transformation of existing power relations.

The first part of the thesis raises questions that strive to situate technological products -and particularly computers in education- within a sociological paradigm. It establishes four main arguments that run through the whole study:

- that most existing accounts of IT in education are inadequate;
- that sociology of education and cultural studies can -and should- add to our social perspectives on the use of IT in education;

- that technological artefacts used in education are socially constructed and can be analysed in terms of a "circuit of cultural production";

- that we could demonstrate the utility of such a model by running it through the development and implementation of a major IT phenomenon, that is Logo.

In the second part of the thesis, analysis is divided in five parts (five analytically distinct "moments"). Through reconstructed accounts of participants and secondary sources, analysis of "moment" 1 (*production*) demonstrates the contingent and unstable nature of Logo as constantly changing and developing technology in the context of the decision-making processes. Analysis of "moment" 2 (*text*) discusses Logo as a "text", its "philosophy" for education, and the embodiment of its epistemological principles in the technical design of the language. Analysis of "moment" 3 (*marketing/economics*) discusses the role of marketing, politics, and economics in the development and evolution of Logo; it illustrates that the activities of mediators like government departments and the microcomputer industrial lobby were crucial to the modification and redevelopment of Logo beyond the context of its initial development. Analysis of "moment" 4 (*context*) situates the introduction of Logo to mainstream schools within its social and political context suggesting that the disintegration of "progressive" education largely constituted the context for the "decline" of Logo during the process of restructuring of formal education in the late 1970s and 1980s. Against this background, analysis of "moment" 5 (*consumption*) discusses the ways in which Logo was received in the educational arena and was implicated in the politics of educational innovation, looking into the place that Logo occupied within the institutional and organisational cultures of mainstream schools. Finally, based on the discussion of Logo as a case-study and the findings thereof, the thesis summarises the main analytic and methodological messages and points to directions for further research.

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ABBREVIATIONS

AERA	American Educational Research Association
APE	Advanced Placement Exams
ARPA	Advanced Research Projects Agency
BBN	Bolt, Beranek & Newman
BETT	British Educational and Training Technology
BIDS	Bath Information & Data Services
BLUG	British Logo Users Group
BT	British Telecom
CACE	Central Advisory Council for Education
CAI	Computer Assisted Instruction
CAL	Computer Assisted Learning
CCCS	Centre for Contemporary Cultural Studies
CD-ROM	Compact Disk- Read Only Memory
CET	Council for Educational Technology
CRICT	Centre for Research into Innovation, Culture and Technology (Brunel University, Uxbridge, UK)
DEC	Digital Equipment Corporation
DES	Department for Education and Science
DFE	Department for Education (which replaced the DES in 1992)
DoI	Department of Industry
DTI	Department of Trade and Industry
ED	Employment Department
EDC	Education Development Center (Newton, Mass.)
ERA	Education Reform Act
ERIC	Educational Resources Information Center
ESRC	Economic and Social Research Council
ETS	Educational Testing Service
EURIM	

ICTs	Information and Communication Technologies
IKY	the Greek State Foundation of Scholarships
ISTP	Index to Scientific & technical Proceedings
IT	Information Technology
JJSS	Jean-Jacques Servan Schreiber
LCSI	Logo Computer Systems Incorporated
LEAs	Local Education Authorities
MSC	Manpower Services Commission
MAP	Microelectronics Awareness Programme
M.Ed.	Master of Education degree
MESU	Microelectronics Education Support Unit
MEP	Microelectronics Education Programme
MIT	Massachusetts Institute of Technology
MIT AI LAB	MIT Artificial Intelligence Laboratory
NCET	National Council for Educational Technology
NCTM	the US National Council of Teachers of Mathematics
NC	National Curriculum
NCoEE	National Commission on Educational Excellence
NDEA	National Defense Education Act
NERIS	National Educational Resources Information Service
NSF	National Science Foundation
ONR	Office of Naval Research
OCA	Office of Computing Activities
PICT	Programme on Information & Communication Technologies
R&D	Research & Development
RM	Research Machines
SAT	Scholastic Aptitude Test
SCI	Science Citation Index
SDC	System Development Corporation
SDS	Scientific Data Systems

SSCI	Social Sciences Citation Index
SST	Social Shaping of Technology
TES	Times Educational Supplement
TI	Texas Instruments
TVEI	Technical and Vocational Education Initiative
WOED	Welsh Office for Education
WCC	World Computer Centre (Centre Mondial Informatique et Resource Humaine)
XEROX PARC	Xerox Palo Alto Research Center
YTS	Youth Training Schemes

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CHAPTER ONE

Introduction

1. The argument. Since the early 1980s, schools have been told by politicians and senior educational policy-makers that they have to jump on the computer bandwagon; the introduction of microcomputers into schools has been a dominant educational theme in both developed and developing countries over the last two decades. Administrators, teachers, pupils and parents often appear excited and engaged in the debate. It is doubtful whether any other technological innovation has ever managed to become so popular so quickly. With few exceptions, the desirability of learning with and about microcomputers is taken for granted by all concerned. In the context of England and Wales, there can be identified a central government promotion of the use of computers in education which has been accompanied by a gradual sharpening of a centrally articulated rationale/policy for educational computing over the past decade favouring the use of computers for teaching and learning across the curriculum[1].

However, the bulk of literature, as well as the development of policy on educational computing has been largely uncritical and technological determinist in orientation. Questions about the social, political and cultural origins and implications of IT in education have been largely neglected and when addressed are always within the "safe" limits set by an enthusiastic advocacy. There has been little debate about the introduction of IT in education which was rushed into, particularly in the period since 1981. Although the ambiguous term "computer literacy" has been coined since the early 1980s, there appears not to have been a single, coherent and convincing rationale for this introduction. There are at least six different justifications that have been used for the promotion of computers in education :

- the **social** rationale
- the **vocational** rationale
- the **pedagogical** rationale
- the **cost-effectiveness** rationale
- a more radical **catalytic** rationale
- the IT **industry** rationale[2]

The application of this typology within the UK context suggests that, while there has been a shift away from a mixed social and vocational towards a pedagogical and, to a lesser extent, catalytic rationale in the late 1980s and early 1990s, the *vocational* rationale seems to be re-gaining ground recently and it is by far the dominant justification. In fact, elements of all the above rationales are existent and interplaying in the current advocacy of IT in education. It seems, however, that the main rationale for the use of computers in education has been a model of education as vocational training in the context of what Beynon & Mackay (1989) have called "the re-shaping of education by the industrial lobby within a populist framework":

> It does not seem coincidental to us that IT in education is developing at the same time as a broader restructuring of the education system. The argument is that the nation's economic performance and the world of work depend on a re-tooled education service (Beynon & Mackay, 1989:255).

At a European level also, recent IT initiatives -backed by the European microelectronics and telecommunications industry- openly subscribe to a mixture of IT-industry, social and vocational rationales, a trend which has largely relegated the world of education to the role of a consumer for European microelectronics products and communications services[3]; Edith Cresson and Martin Bangemmann - European Commissioners for Education and Industry respectively begin a recent European Commission's action plan by writing:

> As our society becomes increasingly based on knowledge and communication, Europeans must, from an early age, learn how to use new information and communication tools. Their future, their place in society, and jobs in particular, are at stake (European Communities, 1997:foreword).

It is worth remembering at this point that the introduction of computers in education has not derived primarily from within the world of education itself. Information and Communication Technologies (ICTs) are artefacts initially developed in other fields (for example, in industry, commerce, communications, space and military research) which have been imported to education wrapped in a rhetoric of "educational potential". This "technoromantic rhetoric"[4] of the last two decades tends to ignore -or at best minimise- the fact that the introduction of "educational" computing in its various facets reflects social and political decisions which are connected to certain assumptions about the relationship between education, society and technological change. We should also bear in mind that classroom practices related to educational computing are always embedded within the organisational dynamics and the cultural context(s) of schooling whereby real individuals with different social and cultural backgrounds, experiences and identities participate daily in complex social interactions and struggles for meaning. Although these two levels of thinking about educational computing can be distinguished analytically, in reality they are intertwined and complex. Therefore, any attempt to understand the social implications of IT in schools presupposes at least the following two:

- an awareness of the social origins and nature of technology and technological change;
- an awareness of school as a dynamic social institution and its recognition as a social, political and cultural arena where different accounts of the world are in a daily confrontation and constant transformation.

With regard to the second point, research evidence suggests that education does not take place in a vacuum; rather, it is a terrain where conflicting ideologies compete and relations of power are inscribed. The argument that schooling is deeply embedded in social and political processes (thus having a key role in social and cultural reproduction and transformation) is usefully summarised in the following words of Michael Apple, a leading contemporary sociologist of education:

> Education itself is an arena in which ... ideological conflicts work themselves out. It is one of the major sites in which different groups with distinct political, economic and cultural visions attempt to define what the socially legitimate means and ends of a society are to be (Apple, 1993:17).

Within the last two decades various forms of radical scholarship have played an important role in stripping schools of the ethical and political innocence attributed to them by functionalist social theorists and policy-makers. Radical critics on both sides of the Atlantic have rejected the consensus-based model of functionalist accounts of schooling which echoed the harmony of Talcot Parsons and described schools as socialising institutions designed to provide students with the values and skills necessary for them to function productively in the larger society. Such functionalist accounts -inspired by the dream rather than the reality of liberal democracy and steeped in the logic of consensus and "role" socialisation- left unexamined questions concerning the relationship of schools to issues of power, class conflict, and social control.

Despite, however, the accumulation of studies illustrating the social and political nature of schooling, sociological work concerned with "educational" technologies is in short supply. It seems that most of the people who do critical sociology of other aspects of education stay away from technology, and the people who do educational technology have little interest in sociology, let alone critical sociology. The critical work done on technology more generally has gained remarkably little attention within educational circles:

> ...sociologists, whatever their field of specialisation, have neglected the emergence in this country of information technology and the way it has taken on many of the characteristics of a new fashion... sociologists of education have hardly begun to explore the issues (Young, 1984:205).

Thirteen years after Young's observation, the situation is not very different; with few notable exceptions[5], educational computing has not become the subject of critical sociological enquiry. As a result, the social, political and cultural origins and implications of educational computing have remained to date under-explored. The social processes and the political decisions involved in the production and "consumption" of IT in education are largely ignored. The current dominance of "technological determinist"[6] accounts of the use of technology in education still obscures how technology both affects and reflects the surrounding social conditions. As a result of this,

> ...all too frequently we act on the implicit assumption that technology is a "neutral tool" whose impact depends wholly on the ends to which it is applied, or that it is an implacable external force, autonomously driving the rest of society in one direction or another (Bromley, 1995:introduction).

This thesis will suggest that the "technoromantic rhetoric" surrounding the introduction and use of IT in education should be opposed in favour of a cautious approach which will highlight the deep entanglement of technologies in education with power as exercised at different levels. In line with Bromley (1995), I will argue that such an understanding requires addressing at least the following key-questions:

- how "educational" technologies are shaped by the context in which they are developed and in turn carry the values prevalent in that context into the sites where the technologies are used (schools in our case); and
- how the power relations of the context where a technology is applied also shape the way it is used.

It is with these general goals in mind that I have sought to develop a "language" for discussing aspects of IT in education from a sociological point of view. I have chosen to discuss the development and evolution of Logo programming language as a case-study in educational innovation. This means that Logo itself is not my exclusive concern here as a technology in its own right; rather it will be the vehicle through which I will argue in this thesis that the introduction of new technologies in education is a process which facilitates the maintenance and/or transformation of existing power relations. Logo was chosen because it is a programming language specifically developed for education carrying with it a particular "philosophy" for education which had been developed alongside but sometimes (as I will demonstrate especially in chapters Five, Six and Seven) in some tension with the programming language itself. With a few exceptions, however, (e.g. Bromley, 1992; Noble, 1991b), neither Logo's initial development nor the implications of its introduction into mainstream schools have been studied from a sociological perspective. This thesis, therefore, may be seen partly as a contribution to the effort to redress this lack of research in the field.

2. The Logo phenomenon: an overview. As I will illustrate in Chapter Five, Logo is a programming language specifically designed for and dedicated to education which was developed during the post-Sputnik era of reforms in US education as an alternative to the prevailing technocentric and behaviourist notions of computer-aided instruction (CAI). It was first developed at the Educational Technologies Laboratory of Bolt, Beranek & Newman (BBN) in 1966, derived from the predominant Artificial Intelligence programming language LISP. The new language (which has thereafter been extensively modified) was originally designed as an interactive tool with a constructivist[7] approach to learning (mainly mathematics) for use mostly by younger children. In the first few years of its development -and given the fact that schools did not yet have microcomputers- Logo remained a research idea shared among a number of research centres worldwide interested in education[8]. During the same time, a number of school-based research projects were set up and versions of Logo were experimentally tested in a small number of US elementary and secondary schools. The Massachusetts Institute of Technology (MIT) Logo Lab was founded by Seymour Papert in 1969 as a separate site for Logo research developing Logo in certain directions within the context of the MIT Artificial Intelligence Lab culture.

Following the introduction of microcomputers into schools in the early 1980s, Logo became available to US and UK schools and it started being used in classrooms at an increasing rate until the middle of the decade. Elements of the "Logo philosophy" for education resonated with the philosophical stance of a number of educators who believed in child-centred environments. For a few "progressive" teachers, in both the US and the UK, Logo became another chance for progressive educational reform. However, the way Logo was taken up in the two countries was significantly different. Overall, the US approach tended to view Logo and the ideas around it as a cultural revolution in thinking about schooling and learning; the British approach saw it mostly as a new method to be integrated with existing materials and methods. Around the mid-1980s the excitement started to wear off as the early inflated expectations did not seem to be realised. The initial atmosphere of dedication to the potential of Logo -most evident in the States- gradually gave way to a more cautious advocacy while experimental studies were providing controversial results about the value of Logo.

The introduction of Logo in mainstream education in the early 1980s as an attempt at radical educational reform happened within an adverse political "climate" which discouraged "progressive", open-ended approaches, and favoured hegemonic "technical fixes" rather than social interventions in education. In this context, the "Logo philosophy" for education and its methods were incompatible with the culture of most mainstream schools and the "educational reform" priorities of the 1980s. Although a significant part of Logo's radical messages were still there at the time Logo reached mainstream schools[9], the changing conditions of the 1980s meant that the possibilities of activating those radical messages became less likely; where it survived, Logo usually became institutionalised and "normalised" within existing practices. It is partly the task of this thesis to provide a sociological explanation -rather than a mere description- of this "pendulum swing" against Logo, attributing due emphasis to the significance of the context of use.

A number of issues arising from this course of Logo will be discussed in this study including the following: what were the social forces and processes involved in the production of Logo? what were the reasons for (as well as the significance of) the move of Logo research from BBN to MIT[10]? what was the social context of use and how did it interact with the introduction of Logo in mainstream schools? how was it that Logo came to be seen so readily as a radical educational philosophy by a small number of teachers? what were the forces which brought that about and how did they shape its route into schools? These and other issues will be discussed in the thesis through the application of a *cultural circuit* analytical model derived from cultural studies.

In the remainder of this chapter, the "basics" of the "Logo philosophy" for education will be outlined.

3. *Mindstorms* and the "Logo discourse" for education. According to Harold Abelson, professor of Computer Science and Education at MIT and a key-figure in its development,

> Logo is the name for a philosophy of education and for a continually evolving family of computer languages that aid its realisation (Abelson, 1980:1).

Logo-the-language (in its constantly evolving versions) has become the material embodiment of the "Logo philosophy" for education which has been developing alongside (and sometimes in tension with) the technological artefact. In contrast to other programming languages, Logo has been accompanied by the discourse of an "alternative educational philosophy" and goals which go well beyond the narrow focus of earlier approaches to educational computing like those of Suppes, Davis and Dwyer[11]. This distinction has -arguably- rendered Logo the most influential advocacy of educational computing to date. It is the combination of the "Logo discourse" for education with the technical artefact "embodying" these ideas that constitutes the relational totality of the Logo "text", a package which -as I will demonstrate later on- has not always been totally consistent[12]. This "text" has been continuously evolving for almost thirty years, with a large number of people helping to create, negotiate and re-create it (not just to disseminate it) in different parts of the world. An ideal study of this evolution would cover the whole "life" of Logo from its very early days until today. In practical terms, however, such a task exceeds the limits of this study. Therefore, there has been a conscious decision on the part of the researcher to focus the analysis of the "Logo text" on its earlier formative stages, on ideas and developments in the 1970s and early 1980s. Given that Seymour Papert and a large number of other researchers have continued experimenting with Logo and constantly re-constructing the "Logo discourse" in the late 1980s and 1990s, the critique developed in parts of this thesis may or may not apply to their current work with Logo.

Out of the large number of people who were involved in the development and evolution of Logo, Seymour Papert is probably the most well-known. His book *Mindstorms: children, computers and powerful ideas* (1980) put together ideas about Logo which had been around throughout the 1970s and became the vehicle through which those ideas (or -more correctly- *a version* of them) reached a wide audience, leading to the emergence of Logo as a cultural icon within the Logo community of the early 1980s. The book presented eloquently the educational "philosophy" which guided the development of Logo and called for an "alternative" vision for education. Today, it still remains a constant point of reference in any discussion over Logo. Few educational books in recent times have generated as much activity -and controversy- within education as *Mindstorms* which had a phenomenal commercial success selling over three quarters of a million copies[13]. Two fundamental ideas run through the book, two major themes which have shaped the MIT Logo Lab's research agenda on computers and education: the first is that it is possible to design computers so that learning to communicate with them can be a "natural" process (so that children can learn to use computers in a masterful way); the second is that learning to communicate with a computer may change the way other learning takes place.

Within months of its publication, pro-Logo and anti-Logo lobbies had developed on both sides of the Atlantic. The fact that claims for the value of Logo in *Mindstorms* were unsupported by traditional-type experimental research results (instead, the claims depended on qualitative descriptive data and were presented as a vision) triggered an explosion of experimental studies which ambitiously undertook to test some of the assumptions in *Mindstorms*, in fact with quite contradictory methodologies and results.

The early 1980s witnessed the development of a "Logo community" among educationalists -especially elementary school teachers- who largely identified with the ideas found in *Mindstorms* and sought to materialise its messages at a time that microcomputers were becoming available to schools. Arriving at a time of social and political unrest whereby some teachers were (still) looking for ways to bring about radical educational change, the “Logo philosophy” had a significant appeal to them by way of offering a “radical” vision for education.

4. Elements of the Logo discourse in the late 1970s and early 1980s.

Logo’s original developers, as well as most of those who have contributed to the shaping of the Logo discourse at a later stage, seem to agree that Logo was the expression of a radical educational philosophy which offered an alternative learning environment to that provided by the traditional educational system. For example, Hoyles & Noss (1992) argue that Logo from the first set out to represent more than simply another programming language; it was designed within a coherent educational framework, it was a "language for learning":

> With the publication of *Mindstorms* in 1980, Papert offered a vision not just of how mathematics teaching might be improved but of a different kind of mathematical learning altogether, one in which the medium of expression (Logo) crucially influences the kinds of mathematical thinking and learning that might take place (Hoyles & Noss, 1992:xviii).

The Logo discourse suggested that at that point in the history of education radical change was possible, and that the possibility for that change was directly tied to the impact of the computer (Papert, 1980:36). It suggested that Logo -as an appropriate application of computers- could help bridge the gap between "humanities" and "science" characterising our culture. For example, Papert (1980) has suggested that computers can be carriers of powerful ideas and of the seeds of cultural change; that they can help people form new relationships with knowledge that cut across the traditional lines separating humanities from sciences and knowledge of the self from both of these:

> This great divide is thoroughly built into our language, our world-view, our social organization, our educational system, and, most recently, even our theories of neurophysiology.... the computer may serve as a force to break down the line between the two cultures (Papert, 1980:38).

The Logo discourse presented the vision of a particular computer culture, a "mathetic" one, that is, one that helps us not only to learn but "to learn about learning". The argument was essentially cognitive/ psychological and ways were discussed in which the computer presence could contribute to mental processes not only instrumentally but in more essential, conceptual ways, influencing how people think even when they are far removed from physical contact with a computer. The Logo discourse argued for an "heuristic" path to (mainly mathematical) knowledge as an alternative to what was viewed as the "dissociated", formal and pseudo-mathematical language of traditional schooling. It promised a radically different way to learning what was earlier a highly abstract, meaningless and inaccessible body of formal mathematical knowledge.

4.1. Logo, educational culture and conservatism. One of the fundamental elements of the Logo discourse has been its ruthless polemic against traditional educational systems. *Mindstorms* maintained that within mainstream schooling and curriculum the students are for the most part *recipients* of formal (and disassociated) bodies of knowledge for which it is assumed they have essentially no prior experience. The developers of Logo -especially those of the "revolutionary" strand[14]- distinguished themselves from those who tended to see the improvement of classroom teaching as the goal of educational research. In an iconoclastic spirit, the conventional classroom was seen as an artificial and inefficient learning environment that society has been forced to invent because its informal environments fail in certain essential learning domains, such as writing or grammar or school math:

the computer presence will enable us to so modify the learning environment outside the classrooms that much if not all the knowledge schools presently try to teach with such pain and expense and such limited success will be learned **painlessly, successfully, and without organised instruction**. This obviously implies that schools as we know them today will have no place in the future (Papert, 1980:9, emphasis added).

The Logo discourse developed the image of a child's relationship with a computer that went in the opposite direction from what was assumed to be the case in common schools. It was argued that the right conditions for the development of this kind of relationship were very different from the kind of access to computers that was becoming established as the norm in schools in the early 1980s, requiring more and freer access to the computer than educational planners had anticipated:

And they require a kind of computer language and a learning environment around that language very different from those the schools are providing. They even require a kind of computer rather different from those that the schools are currently buying (Papert, 1980:16).

The developers of Logo have been at variance with the idea of the computer as an instrument for CAL which resembled traditional teaching methods and appealed to many teachers who saw it only as a teaching instrument for teaching more effectively the traditional curriculum:

In most contemporary educational situations where children come into contact with computers the computer is used to put children through their paces, to provide exercises of an appropriate level of difficulty, to provide feedback, and to dispense information. The computer programming the child (Papert, 1980:36).

The Logo discourse maintained that this kind of computer use reflects a conservatism similar to that reflected in the arguments about the advantages of using BASIC which had until recently colonised the world of education. Papert (1980) argued that this conservative bias being built into the use of computers in education has also been built into other new technologies in a sense that the first use of the new technology is to do in a slightly different way what had been done before without it:

Most of what has been done up to now under the name of "educational technology" or "computers in education" is still at the stage of the linear mix of old instructional methods with new technologies (Papert, 1980:36).

4.2. Logo, culture and maths education. With particular reference to mathematics learning, the Logo discourse maintained that there is a strong "mathophobic" element in modern European and American cultures which prevents even many privileged children from appropriating science as their own:

The mathophobia endemic in contemporary culture blocks many people from learning anything they recognise as "math", although they may have no trouble with mathematical knowledge they do not perceive as such (Papert, 1980:8).

Growing up in a culture permeated by the idea that there are "smart people" and "dumb people", goes the argument, children are faced with the social construction of the individual as a bundle of aptitudes: there are people who are "good at math" and people who "can't do math". It was argued that these popular beliefs about human aptitudes are institutionalised in schools, in testing systems, and in college admissions criteria and, consequently, they are often repeated ritualistically creating a world of taboos:

Deficiency becomes identity...If people believe firmly enough that they cannot do math, they will usually succeed in preventing themselves from doing whatever they recognise as math. The consequence of such self-sabotage is personal failure, and each failure reinforces the original belief (Papert, 1980:42).

For the Logo discourse, what is taught in schools as "school math" is a social construction. It is maintained that a set of historical accidents has determined a choice of certain mathematical topics as **the** baggage that citizens should carry in a way that for most people in our culture it is inconceivable that school math could be very much different. It is argued that in our culture children are forced to follow the very worst model for learning mathematics: the model of rote learning, where material is treated as meaningless, a **dissociated** model. In this sense, the traditional approach accepts school math as a given entity and struggles to find ways to teach it:

> Some educators use computers for this purpose. Thus, paradoxically, the most common use of the computer in education has become force-feeding indigestible material left over from the precomputer epoch (Papert, 1980:51).

Logo was offered as a different approach to the content of school mathematics at the time, which was seen as denatured, alienating and outside of a child's concerns. The computer was viewed as a way to create new learning conditions and new things to learn, as a way of breaking this vicious circle and providing children with genuinely meaningful learning experiences. Logo environments were offered as examples of "a better, more meaningful first area of formal mathematics for children":

> In Logo environments the boundaries have been blurred so that no particular computer activities are set aside as "learning mathematics"... There, the computer has a totally different use from the traditional approach. It is used as a mathematically expressive medium, one that frees us to design personally meaningful, intellectually coherent and easily learnable mathematical topics for children. Instead of posing the educational problem as "how to teach the existing school math", they pose it as "reconstructing mathematics", or more generally, as reconstructing knowledge in such a way that no great effort is needed to teach it (Papert, 1980:48,53).

4.3. Logo environments and turtle geometry. The "turtle" is probably the most common feature of Logo and it was developed as the material embodiment of one of its fundamental principles: the idea of body syntonicity[15]. Turtle geometry with Logo was thought of as providing a rich environment for learning. Its “computational and dynamic style” was juxtaposed to the “abstract Euclidean and Descartian styles” of learning geometry (Papert, 1980). The principle of syntonicity -that is the idea that children could spatially identify with the “turtle” and would thus be able to bring their knowledge about their bodies and how they move into the work of learning formal geometry- was one of the “powerful ideas” guiding the design of Logo:

> Working with the turtle mobilises the child's expertise and pleasure in motion. It draws on the child's well-established knowledge of "body geometry" as a starting point for the development of bridges into formal geometry (Papert, 1980:58).

Convinced that among the goals of children's first experiences in the “turtle” learning environment is not to learn formal rules but to develop insights into the way they move about in space, the designers of the “turtle” argued that these insights could be described in Turtle Talk and thereby become "programs" for the “turtle”. It was argued that through this formal description in Logo commands, the process of children’s learning is transformed, it becomes more active and self-directed while the knowledge is acquired for a recognisable personal purpose; the child does something with it. In this sense, the new knowledge was seen as a source of power for children:

> And in teaching the computer how to think children embark on an exploration about how they themselves think. This process of thinking about thinking turns the child into an epistemologist, an experience not even shared by most adults (Papert, 1980:19).

I will return to the discussion of the “turtle” in chapters Five, Six, Seven and Nine. I will show there that -despite the Logo developers’ original intentions- the idea of the “turtle” became a tension built into Logo.

4.4. Pedagogical relationship and debugging. In terms of pedagogy, Logo was viewed as a source of empowerment for the children as it facilitated talking about the process of thinking. In this sense, the use of Logo was seen as potentially enriching and facilitating the interaction among children and between teacher and children thus offering opportunities for more articulate, effective, and honest teaching relationships:

It is a step toward a situation in which the line between learners and teachers can fade (Papert, 1980:180).

The issue of talking about thinking was also linked to the concept of "debugging", whereby a child is not criticised for an error in drawing but is encouraged to learn from it:

While, in a typical math class, a child's reaction to a wrong answer is to try to forget it as fast as possible, in a Logo environment the process of "debugging" is a normal part of the process of understanding a program. The programmer is encouraged to study the bug rather than forget the error (Papert,1980:61).

This idea of studying errors is one of the "powerful" ideas in the Logo discourse whereby it is argued that many children are held back in their learning because they have such a model of learning in which you have either "got it" or "got it wrong". It is argued that this is also the way the larger culture thinks about knowledge and its acquisition, a notion which results in what is seen as one of the larger cultural impediments: to be intimidated by our fears of "being wrong". It is suggested that programming in Logo conveys the opposite message to the learner:

But when you learn to program a computer you almost never get it right the first time. This potential influence of the computer on changing our notion of a black and white version of our successes and failures is an example of using the computer as an "object-to think-with" (Papert, 1980:23).

> The purpose in working on the problem is not to "get the right answer", but to look sensitively for conflict between different ways of thinking about the problem: for example, between two intuitive ways of thinking or between an intuitive and a formal analysis (Papert, 1980:145).

Influenced by Piaget, Papert argues in *Mindstorms* that children do not follow a learning path that goes from one "true position" to another, more advanced "true position". Rather, their natural learning paths include "false theories" that teach as much about theory building as true ones. But in school, says Papert, false theories are no longer tolerated:

> Our educational system rejects the "false theories" of children, thereby rejecting the way children really learn. And it also rejects discoveries that point to the importance of the false-theory learning path. Piaget has shown that children hold false theories as a necessary part of the process of learning to think. The unorthodox theories of young children are not deficiencies or cognitive gaps, they serve as ways of flexing cognitive muscles, of developing and working through the necessary skills needed for more orthodox theorising. Educators distort Piaget's message by seeing his contribution as revealing that children hold false beliefs, which they, the educators, must overcome. This makes Piaget-in-the-schools a Piaget backward -backward because children are being force-fed "correct" theories before they are ready to invent them. And backward because Piaget's work puts into question the idea that the "correct" theory is superior as a learning strategy (Papert, 1980:133).

5. Logo as a cultural artefact. Within the explanatory hierarchy of the social sciences in general and sociology in particular, culture has traditionally been allotted a rather inferior role. In contrast to economic and political processes, for example, which were routinely assumed to alter material conditions in the "real" world in ways which could be clearly identified and described, and hence to provide "hard" knowledge of the social world, cultural processes were deemed rather ephemeral and superficial. Because cultural processes dealt with seemingly less tangible things -signs, images, language beliefs- they were often assumed, particularly by Marxist theorists, to be "superstructural", being both dependent upon and reflective of the primary status of the material base and thus unlikely to provide social scientists with valid, "real" knowledge. In recent years this has changed and the cultural has come to occupy a much enhanced position in the social sciences. Rather than being seen as merely reflective of other processes -economic or political- culture is now regarded as being at least as constitutive of the social world as economic or political processes. Indeed, theorists have begun to argue that because social practices are meaningful social practices, they are all fundamentally cultural. Therefore, cultural description and analysis is increasingly crucial to the production of sociological knowledge.

Logo is not only part of our culture. It has a distinct "culture" of its own. Around it there have developed a distinctive set of *meanings* and *practices*. The very word "Logo" conjures up an image, or an idea - a concept- of the language (in fact, it evokes different concepts to different people as I will show in the following chapters). We can then use the concept to think about it, or use the word as a sign or symbol which we can communicate about to other people in a variety of different contexts. It belongs to our culture because we have constructed for it a little world of meaning(s); and this bringing of the object *into* meaning is what constitutes it as a *cultural artefact*.

Logo is also "cultural" because it connects with a distinct set of *social practices* (that is education and schooling) which are specific to our culture or way of life. It is cultural because it is associated with certain *kinds of people* (young pupils, for example, and their teachers; with certain *places* (for example, with "progressive" classrooms); it is cultural because it has been given or acquired a social profile or *identity*. It is also cultural because it has become a sort of metaphor which stands for or represents a distinctively "progressive", "radical", or even "revolutionary" (sub-) culture or way of life. These meanings, practices, images and identities allow us to place, to situate, to decipher and to study Logo as a cultural artefact. To study Logo "culturally" is therefore, in part to use it as a clue to the study of modern culture in general. Logo gives us insights into a number of shared meanings and social practices -to some of the distinctive ways of making sense and doing things- which are the basis of our culture.

In this sense, this thesis is an exploration in the sociology of culture setting up an approach to the study of "culture", using Logo as a case-study. Subsequently the analytic approach appropriated in this discussion of Logo can be refined, expanded theoretically and applied to other objects of cultural study. Appropriating developments in the sociology of education, sociology of technology and cultural studies, the thesis will discuss Logo through the application of a "cultural circuit" model (discussed in Chapter Four). Having outlined in this chapter an overview of Logo's lineage as well as some of its fundamental principles, I have provided the reader with the beginning of a narrative which will be continued in the second part of the thesis. This Logo narrative will be interrupted here so that Chapters Two, Three and Four provide the reader with a literature review and a summary of the theoretical/ methodological tools to be used in the empirical study.

Chapter Two will provide a discussion of sociological approaches to technology and technological change. Throughout that chapter it will be argued that, in order to understand what is actually happening (or not happening) in classrooms in relation to IT, we need a theoretical framework which adequately conceptualises culture, ideology, social process, schooling and technological change. It will be suggested that a particular approach derived from the field of cultural studies could be useful for integrating all these five elements. Some advantages of such a *cultural circuit* approach will be discussed against the limitations of existing approaches to the sociology of technology.

Chapter Three will point to the need to interpret schooling, the curriculum, and the use of computers in education as systems of both (social) production and reproduction. Rejecting notions of computer technology as neutral and ahistorical, the chapter will raise questions that strive to situate the use of computers in education within a sociological paradigm and establish four main arguments that will run through the whole study:

- that most existing accounts of IT in education are inadequate;
- that sociology of education and cultural studies can add to our social perspectives on IT in education;
- that technological artefacts used in education are socially constructed and can be analysed in terms of a "circuit of cultural production";
- that we could demonstrate the utility of this model by running it through the development of a major IT in education phenomenon, namely the development of Logo programming language and its introduction to schools.

After a brief discussion of the concept of "computer literacy", a review of sociological literature in the field will be provided which will de-construct some of the ideological strategies employed for the promotion of computers in education. Overall, Chapter Three will argue that

- IT was introduced very quickly in both US and UK education, with little educational rationale and with a very narrow definition of "computer literacy";
- that, in contrast to a sociological perspective, IT in education has been promoted and received generally uncritically with a tendency to be seen as mere artefacts to the exclusion or trivialisation of the importance of the broader social context within which technology is developed and used;
- that an appropriation of recent approaches to cultural studies could be useful for a sociological understanding of IT in education[16].

Chapter Four will discuss the analytical model employed in this thesis and will outline the research agenda for the second part of the study where Logo is discussed as a case-study in educational innovation.

Chapter Five will discuss the social processes involved in the initial development and the struggle over the meaning of Logo at the level of "production". A number of issues will be addressed including the early expectations of its original designers, the tensions within as well as between the research groups, the "culture of production" of the institutions involved, etc. Discussion will be based on analysis of all the evidence available to the researcher, including primary and secondary literature as well as empirical data specifically collected for this study through interviews with the original developers of Logo.

Chapter Six will provide an analysis of Logo as a *"text"*. Firstly, a summary of the fundamental principles guiding Logo's technical design will be provided and the "Logo philosophy" for education will be situated theoretically. Secondly, examples of how theoretical and epistemological principles of the "Logo philosophy" for education were inscribed in the technical design of Logo-the-language will be provided.

Chapter Seven will discuss the role of marketing, politics, and economics in the development and evolution of Logo with a view to illustrate that the activities of mediators like government departments and the domestic microcomputer industrial lobby (particularly for Logo in the UK) were crucial to the modification and redevelopment of Logo beyond the context of its initial development and often at odds with its designers' expectations.

Chapters Eight and Nine will discuss the route of Logo in schools since the early 1980s. Chapter Eight will situate the introduction of Logo to mainstream schools within its social and political context. The main argument here will be that the disintegration of those elements of "progressive" education that had existed in schools largely constituted the context for the "decline" of Logo during the process of restructuring of formal education in the late 1970s and 1980s. Using Chapter Eight's discussion of the social and political context as its background, Chapter Nine will discuss the ways in which Logo was received in the educational arena and implicated in the politics of educational innovation. The chapter will look into the place that Logo occupied within the institutional and organisational cultures of mainstream schools and the power structures already in place upon its introduction.

Finally, based on the discussion of Logo as a case-study and the findings thereof, Chapter Ten will draw out the main analytic and methodological messages and will point to directions of further research.

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CHAPTER TWO

Perspectives on Information Technology

1. Theoretical frameworks for the conceptualisation of technological change.

According to Young (1984:206), conceptualising technology, not just information technology, is increasingly necessary if sociologists of education are to make the critical contribution to issues of educational policy and practice that has been part of their tradition since the 1950s. Different conceptualisations of IT in education depend significantly upon different conceptualisations of the role of technology and technological change. Traditionally there have been two broad competing strands of approaches (models) which have sought to conceptualise the relationship between technology and society, namely *technological determinism* and the sociology of technology (or the *technology as a social construct* approach). These two approaches are sometimes referred to as *technocentric* and *anthropocentric* respectively.

Technological determinism is a position frequently encountered within the History of Technology. It is the view that technology is isolated from society, an independent factor which impinges on society from outside bring about social changes. In their extreme form, technological determinist scenaria depict technology as an irresistible force beyond human control; in such accounts, technology is granted an autonomous existence beyond the arena of morality and human decision-making:

Technological determinism is the notion that technological development is autonomous of society; it shapes society, but is not reciprocally influenced. Rather, it exists outside society, but at the same time influences social change. In more extreme varieties of technological determinism, the technology is seen as the most significant determinant of the nature of a society (Mackay, 1995:41).

Technological determinist scenaria present technological development as unstoppable, as a flood washing the rest of society along the changes it produces. Technology is viewed as an inevitable, beneficial and autonomous determinant factor of social life which somehow exists outside society and has only "effects" or "impact" on it:

It is taken as a given, a requisite of all else, the bedrock, the base, the premise of social existence and the ultimate determinant of our future existence (Robins & Webster, 1989:24).

In their discussion of technological determinism, Young and Barnett (1993) have identified the following interconnected features of technological determinism which require special attention:

- it is deeply embedded in the language (of technology doing things);
- it operates as an ideology converting a partial truth into a whole truth;
- within technological determinism technology refers to artefacts;
- technology is viewed as autonomous, as an outside society active force;
- the development of technology is viewed as inevitable;
- it implies certain forms of work organisation;

Elaborate marketing techniques is one of the ways which the IT lobby promoting IT in education employs for the promotion of a glamorous image of computer products, presenting technological change as inevitable and linking technology with "a roseate picture of a post-industrial wonderland" (for a critical discussion see Webster & Robins, 1991). Bigum et al. (1993) provide us with good examples of technological determinist image-building through their discussion of such marketing strategies aimed at the construction of powerful images of computers. Thousands of examples of such images can be found in the popular press and the media[17]. An analysis of these images reveals that the public apprehensions of IT are soothed by a large dose of optimism expressed in a technological determinist language, a point well registered by Robins & Webster:

> Technology is presented as a panacea and those who refuse to share the enthusiasm of the converted are marked as "future haters" suffering from "technophobia". An air of computer theology dominates the field holding computer technology as the catalyst for social change (Robins & Webster, 1989:14).

Computer technology is presented as, on the whole, benign. Typically, most of the changes are presented as changes for the better: better education, better news media, better forms of human communication, better entertainment, better medical resources, less pollution, more efficient industry, and a better informed society. Technology is also presented as a spectacle, in an attempt to persuade that tomorrow started yesterday:

> ...as something which can evoke only a gee-whiz, awed response, since it entails regarding technology as a phenomenon that has arrived in society out of the blue, although it will have a devastating social effect (Webster & Robins , 1991:78).

The sociology of technology (often referred to as *the social shaping of technology* -SST approach) is the counterpart approach to technological determinism in the study of technology and its relation to social change. Focusing on social, political and cultural aspects, the sociology of technology maintains that technology is a social phenomenon and thus reciprocally influential with the society of which it is a part. Far from treating technology as isolated from society, the SST approach has been concerned to oppose technological determinism by showing how technologies do not follow some pre-determined and inevitable course of development and use but, rather, that they are socially shaped: that technologies are always designed for particular purposes, and -in this sense- they embody elements of the prevailing social relations; their production and use "encode" particular values and are the result of certain political, economic and social choices. Unlike the technological determinist approach which is pre-occupied with the technology itself, the sociology of technology is concerned with the social, cultural and economic context in which the development and use of technology is embedded. While not denying that technologies have social effects, the sociology of technology focuses on the social forces which give rise to particular technologies as well as on the deeply social (and very often private) ways in which users "consume" these technologies in their daily lives and cultures. Within the sociology of technology at least six varieties can be identified, each of them giving primacy to a certain sub-set of ideas and analytical concepts:

- ***the social constructivist*** (or *social construction of technology*) approach, fashionable among historians and sociologists who study technology and society[18], focuses on the design and development of technologies from the perspective of the network of social forces and interactions on which design decisions are based shaping crucially the process of production. It is concerned with studying the inner workings and the social histories of particular technologies, with identifying the relevant social groups involved in the definition and resolution of problems in the initial production of particular technologies. For the social constructivist approach[19], design and development embody a series of values, ideologies and purposes that must be rendered explicit if a technology is to be understood.

Drawing on methodological guidelines established during the last two decades within the sociology of science and the sociology of scientific knowledge, historians and sociologists in this school of thought view technologies as emerging out of processes of choice and negotiation between "relevant social groups". The focus is on design and development, which are seen as embodying these social processes, as encompassing the social interests which they represent (Pinch & Bijker, 1987; Winner, 1985; Rosen, 1993).

- the ***networks or "systems" approach*** sees system builders -inventors, engineers, managers and financiers- creating and presiding over technological systems; heterogeneous people, organisations and disciplines become part of a "seamless web" (Hughes, 1985, 1987)[20].

- ***the "actor-network" approach*** is a programme for empirical research which is different from the social constructivist agenda in that it collapses any distinction between the "technical" and the "social" -and, for that matter, between these and the "scientific", the "economic" or the "political". Dropping any distinction between animate and inanimate things and forces, this approach replaces such conventional categories with the notion of "actors" -physical and social- involved in the development of technological systems (Callon, 1986; Latour, 1987; Law, 1991; Bigum *et al.*, 1993):

> Technological systems, it is argued, are built by the management...of both physical and social actors into networks -using 'heterogeneous engineering', the drawing together of heterogeneous elements... The primacy of human elements in a socio-technical scenario is rejected; rather, the development of a technology is seen in terms of the relationships formed between human and non-human elements of 'actor networks' (Mackay, 1995:43).

- *the marxist labour process and neo-marxist approach* maintain that technology has always been deeply embedded in social life. Marxist analyses have attempted to relate the particularity of social formations to the exact nature of how labour and technology are combined. In contrast to the social constructivist approach they focus on the broader political and economic context within which a technology is developed. Technological change, it is argued, cannot be fully understood by reference to individual inventions; rather, we need to examine how broader socio-economic forces affect the nature and course of technological problems, solutions, developments and uses (i.e. Braverman, 1974; Linn, 1985; Russel, 1986).

- *the feminist approach* focuses on the interaction of technology and gender. It maintains that the other approaches to technology tend to ignore a key element of the construction of technology as a social category, namely the exclusion of women from technology and the role of gender in both the development and use of technologies (Harding, 1986,1991; Haraway,1991; Wacjman,1991; Bromley, 1995).

- **the emerging** ***cultural studies*** approach treats technologies as cultural products with symbolic value for their users. Technology in this tradition can be viewed as a form of "text" which is possibly encoded with a preferred reading by its developers, but one which is actively decoded by its users: technologies can be appropriated by their users for purposes different from the intentions of their inventors. In cultural studies, the social nature of technology is not restricted to its initial, production stage but is also actively constructed during circulation and "consumption", having thus meaning for its users and significance for the construction of their subjectivities (Haddon, 1989; Moores, 1993; du Gay, *et al.*, 1997).

Elements of the cultural studies approach will be discussed in more detail in the last part of this chapter as well as in Chapter Four. Before this, I will look into the insights and limitations of some earlier approaches to the sociology of technology.

2. Key-approaches to the sociology of technology in the 1980s and 1990s.

Sociologists have, until recently, tended to avoid technology. This began to change significantly in the late 1980s with the growth and development of both (physical) IT and the (social) debate surrounding it (Mackay, 1995:41). The second part of the 1980s and the first part of the 1990s have witnessed significant developments in the sociology of technology and a remarkable volume of studies - mainly from a social constructivist perspective- which have established social constructivism as the dominant research strategy and intellectual agenda within science and technology studies. In a broad sense, sociologists of technology are concerned with explaining how social processes, actions and structures relate to technology; and in this are concerned with developing critiques of notions of technological determinism. Breaking with the technological determinist logic, sociologists of technology argue that, rather than being an autonomous driving force of social change, the development and use of technology is the embodiment of a series of social processes and decisions. They maintain that the perception of technology as an innocent and benign force takes responsibility for historical development out of the hands of human beings who make choices, pursue interests and exercise power:

> Technology is an integral part of the social process and, far from being autonomous, it is expressive of social relations; technological innovation is intimately influenced by social priorities and, therefore, incorporates social values (Robins & Webster, 1989:28).

With particular reference to computers and computer-related products, it is interesting that a number of sociologists of technology have attempted to deconstruct some of the marketing techniques often employed for the creation of a certain image of computer products in the larger society, mainly through the popular press. For example, Webster & Robins (1991) provide an illuminating analysis of "mythinformation"[21], that is a critical analysis of the almost religious conviction that a widespread adoption of computers and communications systems along with easy access to electronic information will automatically produce a better world for human living. In a similar spirit, Somekh (1993) provides a vivid description of a particular advertising leaflet (of the British *Research Machines* computer company), where she demonstrates how, by surrounding the central picture with culturally significant objects, the advertiser endows it with power through both a conscious and subliminal appeal to the viewer[22]. Thousands of similarly powerful images can be found in the popular press and the media[23]. An analysis of these images and their discourse reveals that the public apprehensions of IT are soothed by a large dose of optimism expressed in a technological determinist language, a point well registered in the sociology of technology literature available:

> Technology is presented as a panacea and those who refuse to share the enthusiasm of the converted are marked as "future haters" suffering from "technophobia". An air of computer theology dominates the field holding computer technology as the catalyst for social change (Robins & Webster, 1989:14).

Computer technology is presented as, on the whole, benign. Typically, most of the changes are presented as changes for the better: better education, better news media, better forms of human communication, better entertainment, better medical resources, less pollution, more efficient industry, and a better informed society.

Sociological analyses of the social construction of computer technology point out that the technological determinist rhetoric often employed to persuade that tomorrow started yesterday takes responsibility for historical development out of the hands of human beings who make choices, pursue interests and exercise power. Along these lines, Robins & Webster (1989) argue that any perspective which conceives of technology as separate from society is mistaken:

> Technology is an integral part of the social process and, far from being autonomous, it is expressive of social relations; technological innovation is intimately influenced by social priorities and, therefore, incorporates social values (Robins & Webster, 1989:28).

Taken as a whole, sociological analyses of technology view the latter as embodying particular social relations and are concerned with explaining the social processes involved in the development of particular technologies. Using the various approaches, sociologists of technology have produced a range of detailed studies of the development of specific technical devices and systems. For example, they have studied the development of bakelite, missile guidance systems, electric vehicles, expert systems in computer science, networks of electrical power generation and distribution, mountain bikes, etc. Research results usually indicate that technological innovation is a multi-centred, complex process, not the unilinear progression depicted in many earlier writings in the history of technology. Along the way, it is especially social constructivists who have helped debunk the idea that new technologies spring full-born from the work of "great men".

Three paper collections published as edited books (Mackenzie & Wacjman, 1985; Bijker, Hughes & Pinch,1987 and Heap et al., 1995) are representative examples of the amount of serious intellectual labour invested in the field. The first reader

(Mackenzie & Wajcman, 1985), takes a thematic approach which spans a number of sociological traditions with an overall concern with exploring the political economy of technological change. The collection displays a broad range of perspectives with its overall intent being to trace the "effects of social relations on technology that range from fostering or inhibiting particular technologies, through influencing the choice between two competing paths of technical development, to affecting the precise design characteristics of particular processes or artifacts" (1985:24). The theoretical diversity within the sociology of technology is revealed by the inclusion in the volume of considerably diverse contributions like the ones by Langdon Winner (a political theorist), Thomas Hughes (a historian with a systems approach), Ruth Schwartz Cohen (a historian whose focus is on the technology-related strengths and weaknesses of female labour power), Cynthia Cockburn (a marxist feminist who stresses both the economic and subjective barriers to women's participation in technology)[24].

The second publication with a major influence in the second part of the 1980s (Bijker, Hughes & Pinch, 1987) is located within empirical sociology and history. Drawing largely on analytic frameworks developed within the sociology of science, the volume concentrates largely on the content of technology, on the design and development of particular technological artefacts, discarding most of the earlier approaches to technology advocated by historians, philosophers and economists. Three approaches have guided the studies in the volume. The first, the social constructivist approach, has been inspired by studies in the sociology of scientific knowledge. One of the central tenets of this approach is the claim that technological artefacts are open to sociological analysis, not just in their usage but especially with respect to their design and technical "content". The second approach, stemming largely from the work of the historian of technology Thomas Hughes, treats technology in terms of a "systems" metaphor. This stresses the importance of paying attention to the different but interlocking elements of physical artefacts, institutions, and their environment and thereby offers an integration of technical, social, economic and political aspects. The third approach, attempts to extend the linking with the wider society one step further. It does this by breaking down the distinction between human actors and natural phenomena. Both are treated as elements in "actor networks". Pinch & Bijker (1987) refer to the theoretical diversity included in the collection as "the fruitful and stimulating heterogeneity of the emerging field". This theoretical diversity is represented in the collection not only in terms of the above three distinctively different theoretical approaches but also in the variety of the empirical cases explored: bicycles, missiles, ships, electric vehicles, electric power systems, the cooking stove, pharmaceuticals, ultrasound, dyes, expert systems, etc.

A third reader devoted to the examination of the relation between technology and society is Open University's *Information Technology and Society* (1995). Providing home for a number of theoretical perspectives on the social shaping of technology, the collection examines the social, political and technological implications of the so-called "information revolution". Divided into five parts, the book presents historical and comparative perspectives on the social and technological processes involved in the uses of, control of and access to IT, while at the same time examining some of the assumptions underpinning technological development. The collection addresses a number of themes including IT in the workplace, IT and learning and IT in the home. How are these developments controlled, by whom, are they inevitable, are IT innovations driven by technology or by social factors, who has access to the technology and who benefits, are some of the questions asked in the volume. It is suggested that a critical attitude to developments in IT should be adopted, recognising that the ways in which technological advances are used are not decided by technical factors, but by social influences that determine both the design and implementation of IT innovations.

3. The PICT Programme[25]. Another example of intellectual (as well as enormous financial) investment on the production of studies on technology in the decade between 1985-1995, has been the ten-year, multi-phase social science research Programme on Information and Communication Technologies (PICT) established by the ESRC in 1985. Adopting a variety of approaches to the study of technology, the programme has produced an impressive volume of studies -most of them, however, preoccupied with a socio-economic orientation dictated by the programme's official priorities. However, despite the predictable lack of a critical sociological dimension which characterises the majority of the research studies produced by PICT, there has been a small number of studies produced within the framework of the programme which escape this depressing rule. For example, although David Morley and Roger Silverstone were among the many researchers involved in the PICT programme, later on in this chapter I am going to draw on their work as exemplary in the area of cultural studies of technology. It seems, however, that Morley and Silverstone's involvement in the PICT has not influenced the general character of the programme. Despite its impressive volume and potential, PICT research has remained preoccupied with the economic implications of information and communications technologies within a functionalist framework largely defined by the business and industrial lobbies which have commissioned and heavily funded the project. The dominant flavour of the concluding PICT 1995 International Conference (which the author attended) was a mixture of technological determinism, "information society" futurology and optimism for a thriving European IT industry. This perspective was invariably shared by politicians of different affiliations[26] and enthusiastically applauded by European Commission's Industry Commissioner who addressed participants on his views of the "European and Global Information Society"; it is instructive that, following Dr. Bangemann's speech, Lord Renwick (Chairman of EURIM) commented that Dr. Bangemann is "a Commissioner with whom we can do business".

Certainly there are a large number of questions for the Programme's independent evaluators[27] to pursue; an interesting one is the extent to which some of the potential of the project to raise critical and/or politically sharp questions and objectives was compromised in view of the funding possibilities available under the dominant definition of "acceptable" research proposals. Another issue is the fact that -despite its otherwise enormous volume and range- PICT failed to address adequately the issue of IT in school education. My impression is that school education has not been a legitimate field for research within the programme; rather, it has been reserved as the territory of the Coventry-based National Council for Educational Technology (NCET). To the extent that education has appeared as a concern of the programme, this was done mainly through research questions linking education to the "needs of industry", productivity, and European competitiveness against overseas business, with many studies adopting a definition of "education" as vocational education and training for competitive business performance.

4. Limitations of existing approaches to the sociology of technology. An existing problem within the sociology of technology, is the tendency of some theorists to employ social determinism to replace technological determinism in a way that critiques often become totally dismissive of technology. Thus, there are writers who fight technological determinism with rigour but eventually subscribe to some version of equally impotent social determinism in their critique. For example, Robins & Webster (1989) advance a critical analysis of IT which - although revealing- ends up almost as inflexible as the technological determinism it sets out to deconstruct.

The potential of the sociological critique of technology has been further reduced by certain limitations of individual approaches to the sociology of technology. For example, none of the collections discussed earlier seems to be able to offer a reasonably coherent approach; rather- they provide surveys of the directions, dissimilarities and convergencies within the sociology of technology in the 1980s and 1990s. Moreover, all the four collections display a tendency to neglect or minimise the social (despite their rhetoric to the opposite) in that -despite their rich theoretical diversity- they all contain an underlying implicit common notion about technology as artefact, a *physicalist* notion of technology. Although the category "technology" is a social category, these accounts do not seem to give enough attention to the construction of this category. While there is detailed and valuable material on the ways in which particular technologies are designed, developed, adapted and deployed, these refer to particular **artefacts**; the production of technology as a social category is quite absent from most accounts. This physicalist notion of technology is a limitation of approaches to the sociology of technology well beyond the collections under discussion. Within sociology (industrial sociology in particular) the focus has remained largely on an asocial pedestal of technical exclusivity and expertise. The focus of industrial sociology on hardware, and on paid production, has contributed to a powerful, taken-for-granted view of technology in sociology. By uncritically linking technology to production, sociology has reproduced the strong association between technology and machines, between technology and hardware, an association which works to remove technology from sociological analysis.

Moreover, part of the literature in the sociology of technology has been preoccupied with the material production of technological products (for example, Cowan, 1985; Hughes, 1985). By identifying technology solely with hardware and the processes around its production, such approaches are characterised by a determinism which denies -or at best minimises or infers- the social, political and cultural context which frames other "moments" in the life cycle of technological products. From this point of view, it can be argued that, as a "corrective" of technological determinism, the sociology of technology approach "has its own shortcomings" (Winner, 1985) in that it shares with technological determinism a preoccupation with the first sphere of a technology -its conception, design and development (production). Unlike technological determinism, however, it reveals a spectrum of possible technological choices, alternatives and branching points within patterns sometimes to be necessary, emphasizing contingency and choice rather than forces of necessity in the production of technology.

Yet, there has been little work which has focused on the full life cycle of a technology. Cowan (1987) links most explicitly "consumption" and production; she sees her work on stoves as extending the social constructivist approach, by applying an actor-network framework to consumers. Haddon's work (1989) on the home computer is an example of such an approach. Mackay's research on the Apple Macintosh is also an attempt to apply empirically the approach he is suggesting (Mackay & Powell, 1993). More recently, Cockburn and others have produced some important work on the microwave and other technologies (Cockburn & Ormrod, 1993; Cockburn & Dilic, 1994). With few exceptions, the sociology of technology has, in general, failed to look at the context of "consumption" and thus at the subjective, social appropriation of technologies. Therefore, the accounts it provides are most often incomplete because they largely fail to consider the social forces at work at the other side of the technology: the way that technologies come to be actively appropriated by their users. Recent work in media and cultural studies which focuses on the domestic consumption of information and communication technologies -on video (Gray, 1987), early radio (Moores, 1988), home computers (Haddon, 1989), and other ICTs (e.g. Silverstone & Hirsch, 1992) has suggested that people are not merely malleable subjects submitting to the dictates of a technology or the "texts" coming with/from it: in their "consumption" they are not the passive dupes suggested by crude conceptions of ideology but, rather, they are active, creative and expressive -albeit socially situated- subjects. Authors argue that all technology "consumption" involves the consumption of meanings; in fact, it involves the *production* of meanings by users as any technological product is not isolated but it exists in a social, political and ideological context:

> The meanings of modern technological artefacts cannot be found in the objects themselves, but in relating the symbolism of the object to the cultural context and world-views within which the meanings of the immediate object are located (Hill, 1988:46).

Users may reject technologies, redefine their functional purpose, customise or even invest idiosyncratic symbolic meanings in them. Indeed, they may redefine a technology in a way that defies the original intentions of its designers. My discussion of Logo later in this thesis will provide concrete examples of this point. In this sense, the *appropriation* of any technology becomes an integral part of its social shaping. Yet, with few exceptions (e.g. Hill, 1988; Mackay & Gillespie, 1992;) the sociology of technology seems to have largely neglected the question of how the "encoding" of production interacts with appropriation. It is mainly through the work of sociologists of culture and media audience researchers (developing case-studies of technological artefacts as cultural objects and audience studies respectively) rather than through the work of sociologists of technology that attention has recently been drawn to the deep interconnection between technology and culture. In this direction, the work of Morley & Silverstone (1990), Moores (1993) and, most recently, the case-study of the SONY Walkman by the Open University course team (du Gay *et al.*, 1997) are exemplary.

5. The cultural studies approach to technology. The emerging field of cultural studies[28] suggests that in order to examine the sociological constituents of a technology it is necessary to go well beyond the stage of "production". By this it is not meant that analyses of the arrangements over the development, of the physical design and encoding, of marketing considerations, or studies of the political economy of production are not important; I mean that studying the "moment" of production in the life-cycle of any technological product is necessary but not sufficient. Technologies need to be treated as **cultural** (that is to be treated as artefacts with *symbolic* value for those who use them) and therefore as artefacts with properties which -in turn- produce and re-produce meanings. Cultural studies approaches to technology emphasise that meaning-making lies at the interface between culture and technology and draw a close connection between *culture* and the *media,* between the meanings and practices which form the basis of all modern culture and the technological means -the media- by which much (though not all) of that culture is now produced, circulated, used or appropriated. No study of late-modern culture could afford to neglect -as an essential part of the study of the culture as a whole- the rapid development of new media. I include in this term the actual technologies, the corporate institutions which manufacture, sell and distribute -now on a global scale- both the "means" and the "meanings" which sustain the cultural process as well as their economic role and function[29]. Today, the production and consumption on a global scale of "cultural goods" represents one of the most important economic activities. In addition, each of these new media technologies has a particular set of practices associated with it -a way of using them, a set of knowledges, or "know-how"- what is sometimes called a social technology. Each new technology, in other words, both sustains culture and produces or reproduces cultures. Each spawns, in turn, a little "culture" of its own.

A number of authors in the late 1980s and early 1990s have suggested that cultural studies can enhance our social perspectives on technology (e.g. Haddon, 1989; Percy, 1991; Beynon & Mackay, 1992; Moores, 1993; du Gay *et al.*, 1997). They argue that by treating technological products as *cultural products*, cultural studies have the potential to move away from a notion of technology that is simply concerned with artefacts as physical objects and their material production. By stressing the dynamic interplay of (analytically) different "moments" in the "life-cycle" of cultural products, these scholars have maintained that cultural studies can provide a more adequate account of the complexity of technology as a cultural phenomenon. Extending the SST approach, the cultural studies approach leads us to analyse technology *not solely* as the product of design choices and negotiations, but as a product of at least three conceptually distinct spheres which, in reality, are not discrete, causally related, or sequentially ordered:

- conception, design and development;
- marketing; and
- "consumption" and/or appropriation by users.

Cultural Studies is by no means an entirely unified perspective (see Agger, 1992 on this); rather, the field embraces a range of theoretical perspectives and methodologies. Overall, however, cultural studies approaches turn upon an attention to both the production and "consumption" of cultural forms, values and meanings- rather than remaining preoccupied solely with illuminating the social processes involved in the development of technological products. There has been only a limited amount of writing within cultural studies which has focused explicitly on technology. It is not the aim of this chapter to review this literature comprehensively. Rather, my purpose here is to flag up some of the fundamental elements of a generic cultural studies approach to technology as a means of drawing out the key forms of analysis which the "discipline" might bring to the study of IT in education.

It seems that -at least in the British context- it is the presence of technologies in the domestic sphere which has attracted mostly the attention of cultural researchers, not so much as technological artefacts in their own right but, rather, as carriers of meanings through the texts that the technologies provide access to. For example, in addition to the studies already mentioned earlier in this section, Morley & Silverstone (1990) have focused their analytic efforts on the domestic "consumption" of television, drawing largely on the tradition of the Birmingham Centre for Contemporary Cultural Studies (see Appendix Three); Moores (1993) has also studied the domestic "consumption" of satellite TV. Buckingham (1987) has investigated some of the reasons for the extraordinary popularity of *Eastenders* (Britain's newest soap opera at that time), focusing on the relationship between the programme and its audience - a relationship which is both diverse and at times highly contradictory. Finally, the work of du Gay *et al.* (1997) offers not only an introduction to key issues and debates in contemporary cultural studies but also a practical illustration (through their discussion of the SONY Walkman) of how cultural studies can be used to make sense of our everyday lives. In the remainder of this chapter I will discuss briefly a small number of research studies which - while they reflect the fundamental elements of a generic cultural studies approach to technology- they share (implicitly or explicitly) the idea of employing a specific "circuit of culture" analytic model, an approach to cultural studies initially introduced by Richard Johnson at the Birmingham Centre for Contemporary Cultural Studies (CCCS). This model will be discussed more extensively in Chapter Four.

6. Example 1: the domestic "consumption" of television. Morley & Silverstone (1990) have provided a framework for the redefinition and analysis of television in terms of its status as a domestic technology with two distinct ambitions: first, to refocus the problematic around the study of television contextualising it within a wider and a more adequate sociotechnical and cultural frame; second, to draw in other domestic technologies into this same socio-technical frame. Morley & Silverstone maintain that television should not be seen in isolation, but as one of a number of information and communication technologies, occupying domestic time and space. They suggest that television has to be seen as embedded within a technical and consumer culture that is both domestic and national (and international), a culture that is at once both private and public. Their approach defines television as an essentially domestic medium, to be understood both within the context of household and family, and within the wider context of social, political and economic realities. In this sense,

> television's meanings, that is the meanings of both texts and technologies, have to be understood as emergent properties of contextualised audience practices. These practices have to be seen as situated within the facilitating and constraining micro-social environments of family and household interaction. These, in turn, must be seen as being situated in, but not necessarily determined by, those of neighbourhood, economy and culture in which acts of consumption (of both texts and technologies) provide the articulating dimension (Morley & Silverstone, 1990:33).

Morley & Silverstone consider television as an object of both material and cultural consumption, which, in its double articulation, is both meaningful in itself (in its marketing and in its deployment) and the bearer of meanings. They understand television as one focus of a complex economy of meanings. They argue that the purchase and subsequent use of television, video, cable, satellite equipment and their incorporation into the daily lives of their users (as technologies and as carriers of meanings) transforms their status as commodities into objects of consumption:

> The goods bought, the meanings appropriated and transformed, are embedded in a social web of distinctions and claims for identity and status. To make sense of the ways in which television is and might be used, then we need to understand the nature and consequences of the choices that are daily made in the public and private acts of consumption (Morley & Silverstone, 1990:49).

The authors find that within communication studies, television has conventionally been analysed textually in terms of reading or reading the text, and that the two main assumptions of this approach were that there is a strong message/content conveyed and that the audience are more or less passive recipients of this message. Morley & Silverstone relatively de-emphasise the importance of text/content. They put emphasis on the many features of the context in which viewing takes place and interpretations and meanings are constructed and transformed. Thus, Morley & Silverstone argue for a position which requires a commitment to ethnographically focused empirical work. Their interest is firstly in the internal dynamics of households, on the patterning of age and gender differences, as they bear on the uses of television and other information and communication technologies and secondly, in the external dynamics of households as their consumption and use of these goods, services and meanings defines a relationship to the outside world. Having a two-fold notion of consumption -the consumption of technology as a commodity and the consumption of text- they argue (1990:36) that the materiality of television (and of other communication and information technologies) cannot be ignored because television is a technology which is articulated through two sets of meanings, one related to the technology, one to the text. The first set is the meanings that are constructed both by producers and consumers (and consumers as producers) around the selling and buying of all objects and their subsequent use in a display of style, as a way to membership of community or subculture. The second set is the mediated meanings conveyed by those technologies. Both sets are open similarly to negotiation and transformation. This duality of meaning in Morley & Silverstone draws attention to both the material and symbolic dimensions of television technology. While recognising the complex nature of the domestic setting in which television is viewed, Morley & Silverstone do not abandon concern with the texts it communicates.

7. Example 2: the domestic "consumption" of satellite TV. In a tradition similar to that of Morley & Silverstone, Moores' qualitative work on the "consumption" of communication technologies in the home (Moores, 1993a,b) applies a critical ethnographic methodology. Employing oral history techniques in addition to ethnographic methods, Moores has been concerned with charting the initial entry and incorporation of new media technologies into the private sphere. Moores (1993a,b) addresses a number of theoretical and methodological issues related to ideology, audiences, technology and cultural "consumption". Moores (1993a) reviews a range of qualitative audience research studies and outlines a critical ethnographic perspective on everyday consumer practices. He considers the distinctive features of audience ethnography and outlines its applications in communication and cultural analysis discussing four main areas of inquiry:

- the power of media texts to determine the meanings made by their readers;
- the relationship between media genres and the social patterns of taste;
- the day-to-day settings and dynamic social situations of reception; and
- the cultural uses and interpretations of communication technologies in the home.

Investigating the satellite TV's cultural significance as an object of domestic consumption, Moores (1993b:627) insists on a more situated theory of subjectivity and discourse that recognises a measure of human agency and understands meaning as negotiable. For Moores, the term *consumption* is undergoing something of a rehabilitation in media and cultural studies at present:

> In the past, it has often been placed alongside production in a binary opposition, with passive consumption as the poor relation to an active production (Moores, 1993b:621).

Moores underlines the fact that recently a number of theorists have begun to redress the imbalance by referring to consumption itself as "productive", recognising it as a moment at which objects and texts are actively appropriated and interpreted as they come into contact with the everyday practices of social subjects. Of course, says the author (1993b:622), in focusing on the meanings that consumers create when they "read" satellite TV, we should be careful not to lose sight altogether of the technology's material design and marketing or the sounds and images that are broadcast. For Moores, satellite TV's significance is partly determined by its positioning within the home and residential area, but the moments of manufacture and promotion also exert considerable pressure on reception activity.

Moores employs the term *embedding* in an effort to stress the situated nature of consumption practices and cultural objects. Drawing on Silverstone's work (1990), Moores argues that studying the position of satellite TV in the day-to-day lives of social audiences necessarily involves an understanding of the technology as "embedded" at several, interconnected levels or instances. Primarily there is the level of household and families which includes spatial divisions inside the home, the temporal routines of its inhabitants and the interpersonal ties and tensions that have formed between household members. Any new commodity which arrives will inevitably become enmeshed within the existing dynamics of power in the domestic realm. It therefore, has to be analysed in conjunction with the range of artefacts and activities that are already in place.

Moores' concept of *articulation* corresponds to none of the dual meanings of the term identified by Hall (1986); it neither refers to the act of speaking (to the production of linguistic utterances) nor to the linking together of two separate things. While Moores retains the double-edged meaning of the term, he uses it quite differently. He is concerned with the ways in which a new media technology gets "hitched up" to lived cultures of consumption, and thereby enables social subjects to actively voice senses of identity and distinction. As satellite TV is embedded at each of the levels outlined above, articulating with relations in and between the private and public spheres, it gives consumers an opportunity to articulate their subjectivities. The continual dialogue between artefact and everyday contexts is what transforms satellite TV into a multi-accentual sign and what allows it to function as a "medium" for cultural forces of identification or differentiation[30].

8. Example 3: the circuit of the BBC microcomputer as a cultural artefact.

Haddon (1989) argues that a "circuit of production" (or "circuit of culture") cultural studies perspective can extend our understanding of the social nature of technology, and applies this perspective on the cultural production and "consumption" of the BBC microcomputer. Haddon looks into how the development of the BBC micro has been shaped by a variety of producer interests and visions. He discusses a range of agencies who "produce" meanings around technology other than manufacturers (like ministers' speeches, the DTI initiative to finance microcomputers at schools and the BBC Computer Literacy Campaign of the early 1980s). He also demonstrates that magazine, software and peripherals producers contributed products which were symbiotic with the micro and which could be seen as interrelated texts. In addition, he shows that the major development which was to engulf the home computer market generally was the rise of games-playing and the narrowing of the micro's role to one of a games machine. In analysing the history of the home micro, Haddon (1989, 1991) draws upon discussions concerning how artefacts are socially constructed and refers explicitly to Johnson's "circuit of production" as a framework for understanding the production and "consumption" of the home computer:

> ...Johnson's paper discussing the object of cultural studies research offered a starting point for asking about the elements which might constitute this particular cultural form. His description of a circuit of cultural production could also serve to draw attention to and theoretically locate the different types of cultural studies (and other) analyses which could be brought to bear on the micro as cultural object (Haddon, 1989:12).

Haddon collapses Johnson's analytic distinction between four different "moments" into two analytic categories referred to as "production" and "consumption". First, he situates the life of the BBC machine in a whole web of social institutions and practices -considering the various stages of production, marketing, and use. Accounting for the emergence and popularity of the home computer in Britain in the early 1980's, he traces the roots of the BBC micro back to both early hobbyist machines in the UK and USA and through the lineage of interactive games (drawing mainly on interviews with producers). The author outlines the history of electronic games from mainframes and minis, through arcades to home video games, an exercise which includes looking at both company strategies and the development of the industry as a whole; charting the changing nature of games as text; and piecing together existing data concerning the playing of video games.

Looking into the way in which the home micro itself became a games machine, Haddon discusses the role of US companies in the development of games-playing, and the response of these firms to the increasing popularity of this activity. Next, he discusses the views and aspirations of British hardware companies as regards the games market. He follows up this discussion with an outline of the emergence and restructuring of the UK software industry, and of magazines which supported and promoted games. Finally, Haddon focuses on youth as key users of home micros, especially for playing games. He explores the nature of interest both in and out of schools. Based on this qualitative material, Haddon investigates the differences in the way boy and girl users "read" and experience micros discussing why home computers were more popular with a male audience.

9. Conclusion. Despite their identification with a "cultural studies" approach, each of these examples tends to "privilege" one or more moments of the circuit. The fundamental elements of the cultural studies approach, as conceived by

Johnson, are perhaps most clearly reflected in the exemplary analysis of the SONY Walkman by du Gay *et al.* (1997) which will be discussed in Chapter Four.

Following up on the theoretical discussion of technology in this chapter, Chapter Three will narrow down the focus of discussion from technology-in-general to the discussion of IT in education. The chapter will de-construct some of the ideological assumptions these traditions rest upon in an attempt to understand how these established rationales have interacted with social, political and economic imperatives of the broader social context. The chapter will also review sociological literature in the field pointing to the inadequacy of existing analytical frameworks for a sociological understanding of IT in education. Through the discussion of the introduction of computers in education, the chapter will illustrate how "production" does not stop at the point of material production of a technology as physical artefact (computers in this case) but, rather, is continued well beyond that stage as computers have to be socially re-invented as "educational tools", marketed, and incorporated in the context(s) of schooling. As discussion in Chapter Three unfolds, examples will be given of how the computer was "encoded" with a plethora of layered meanings as a polysemic *cultural artefact* colonising the world of education. This more focused discussion of computers in education will reinforce the case already made for a cultural studies approach to the study of IT in education.

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CHAPTER THREE

Computers in Education: towards a sociological understanding

1. Introduction. One of the most prominent policy trends in present-day school systems is the rapid introduction of computers into classrooms. Governments around the world have spent billions of taxpayers' pounds on educational computing "initiatives" during the last two decades, which have laid the foundation for current developments (for a review of IT in education policy in the US and the UK see Append. One and Two). With particular reference to the UK,

> The scale of investment in the microcomputer during the 1980s...has been on a level which no other item of educational technology has ever equalled or is *ever* likely to match (Wellington, 1990:57, original emphasis).

Perhaps the most common rationale for this flood of hardware and software is the concept of "computer literacy", which quickly became the main justification for the introduction of microcomputers in US and UK schools in the early 1980s[31]. However, as I have already mentioned in Chapter One, the ambiguity of the term "computer literacy" and the plethora of rationales for educational computing reveals that different people, at different kinds of institutions with different agendas, attach different meanings to "IT in education" and to other elements of what is a largely confusing terminology for the uninitiated. Although "computer literacy" has preoccupied the literature for some years, the term is slippery and there is still a significant conceptual confusion over its meaning:

> Competing definitions have rendered the term 'computer literacy' almost meaningless. Some proponents of computer literacy emphasise the need to provide students with a complete set of computer skills, information on how they are used, and knowledge of their effects. Others urge a less structured approach, allowing students to learn about computers through writing, drawing, or composing music. Finally, an emphasis on computers as communications media leads to the stressing of applications such as electronic mail, computer conferencing, or the ubiquitous 'bulletin boards'...(Ragsdale, 1988:60).

Goodson & Mangan (1996), argue that "computer literacy" is a concept which is so unclear as to purpose and procedure, that it may best be investigated as a form of ideology:

> The concept of computer literacy, however, is poorly defined and delineated... the vagueness surrounding this concept is not entirely accidental, nor the mere result of confusion among its proponents. It may, instead, result from the fact that 'computer literacy' is a largely ideological concept, whose fuzziness and internal contradictions frequently serve to mask the social, political, and educational agendas of its proponents. A critical treatment of computer literacy as an ideology may illuminate this pervasive trend in educational policy (Goodson & Mangan, 1996:65).

In the British context, it seems that the meaning of the term has considerably changed over the last decade; it has had an evolving character from meaning an exclusive preoccupation with teaching *about* the technical features of computers towards a more balanced thematic which includes learning *with* computers and also -to a lesser extent- learning about the "social implications of IT" [32].

2. The context of IT in education policy. There have been a number of accounts of IT in education policy, both professional and non-professional, sometimes critical or even dismissive, sometimes supportive or commitedly defensive, indicating thus the range of opinion in the debate about computers in education. However, what is usually ignored in many of these accounts is that the policies for IT have been only a part of much more wide-ranging reforms of the education system as a whole. In the British case, the reforms can be seen as part of a New Right agenda that combines a neoliberal commitment to market forces with a neoconservative reassertion of traditional values, both aspects of a broader political project to develop a free economy and a strong state. In the case of England and Wales, these include both reforms such as central government specifying a National Curriculum, and reforms which have shifted control over education away from Local Education Authorities (LEAs), responsible to locally elected Education Committees, to individual schools (see Whitty & Power, 1997 for a review of the whole package of school reforms introduced by the Thatcher and Major governments in Britain). Money has been targeted and concentrated on these reforms, including the introduction of IT, by cutting back on funding for other aspects of education. The pressure on schools to introduce the use of computers has also coincided with the lowering of teacher morale resulting from the erosion of their pay, shortages of other resources, and a consistent attack by politicians and the media on the education system in general and teachers in particular.

It is often the case that accounts of IT in education policy (as well as policy documents themselves) tend to disconnect IT in education from its deeply social and political qualities. Already in the introduction of this thesis the argument was put forward that all aspects of education are deeply social and political; there is no need to repeat the argument here at length. Schooling has traditionally been a terrain of conflict, and educational innovation has always been contested and negotiated. Yet, the introduction of microcomputers into schools has not had such a contested character; IT has been presented as a panacea for all the ills of education, arguably with a considerable appeal. What are the elements that have made such an ideological campaign so successful? How have the computer and the subsequent waves of computer-related products (like, for example, multimedia and CD-ROMs) become strong cultural symbols in education? How is the computer constructed as a talisman? Who wins, who loses and who is left out in this game? What are the consequences of such an ideological construction for education and for the life and work of people in educational institutions? A growing (yet still embryonic) body of sociological literature attempts to answer these questions drawing largely on the perspectives of the sociology of technology (discussed in Chapter Two), of the sociology of education, and -last but not least- of cultural studies. This thesis is understood as a contribution to this literature. It argues that what is so often phrased as a question about technology (e.g. 'What is the effect of 3 million computers in American schools?') is in fact a question of social processes and priorities; that the first requisite to understanding what is at stake is therefore an approach for thinking about technology *in its social and cultural context.*

3. The social construction of IT in education. Largely echoing the concerns of the sociological approaches to technology discussed in Chapter Two, critical sociological writings which particularly address the area of IT in education attempt to deconstruct the various elements of the rhetoric upon which the IT in education campaign rests and thus highlight some of its social, political and cultural implications:

> we need to be able to read the myths associated with the technology "appreciating their hidden meanings rather than being taken in by the story (Mackay, 1991:3).

For example, one aspect of IT in education which critical sociological accounts focus upon is the construction of the urgent need for "computer literacy" by the current stream of IT promoters. This body of critical literature deconstructs the alarmist rhetoric (reminiscent of earlier debates about the so-called 'literacy crisis') which is often employed by the popular press (while at the same time survives in a wide range of educational policy documents) urging educators to promote widespread "computer literacy". It is argued that beyond the question of "take up", the press has put very few issues on the IT in education agenda:

> The dominant genre in the media's reportage of education and converging technologies takes the following form: excited pronouncements about new software and applications, attractive images of enthralled children seated around the screen and engaging tales about their travels in cyberspace. Evident here is a repetition of the history of hype which occurred when microcomputers first came on to the market -basically a hard sell through soft images (Kenway *et al.*, 1996:16).

These sorts of stories act to create demand while at the same time they conceal the difficulties involved, thus creating quite unrealistic images of what is readily possible. We should not forget, however, that -first and foremost- computer-related product companies certainly see education and training as an important market; and when markets and new technological products come together it seems that nothing is sacred -certainly not education:

> Technology is where the money is in education. Most educational computing conferences, (exhibitions, expos, trade fairs) demonstrate this. At these events, multi-million dollar computer companies market their wares and seek to capture the custom of educators with promises about what technology can do for them, their students and their schools (Kenway *et al.*, 1996:17).

Overall, marketing campaigns have traditionally tried to attach to computers what appear to be explicit "educational" attributes, that is offering either to do something that schools cannot do, or improve in some way something they already do (Bigum *et al.* call this last the *enhancement* metaphor):

> ... the process by which technologies like CD-ROMs and other multimedia-related products achieve their significance in schooling is... irredeemably social... The social acceptance of any technology requires, at a first stage, a period of invention... That is, after material development, the product has, in a sense, to be reinvented socially. If it is to survive in education, it has, over a relatively short period of time, to become an educational necessity. This is what makes multimedia products so interesting at this time. As yet they are not regarded as essential and so it is a good time to observe the processes, the social construction which occurs (Bigum *et al.*, 1993:44).

If an urgency can be created about acquiring the product, all the better. A marketing strategy for achieving this sense of urgency is described by Bigum et al. (1993) who argue that the selling of computers and their related products to schools, in part, requires that the product is "reinvented" or constructed for educational purposes and, further, that the categories of schooling (students, teachers, classrooms and curriculum) are, more or less, represented as caricatures of schooling from the 1950s and 1960s:

> Extreme caricatures of educational institutions and practices characterise representations of schools and learning by advertising agencies. If we were to accept these representations of schooling, it would seem that since the very earliest days of computing in schools, schools have been caught in a kind of time warp, around about 1950 or 1960, desperately in need of transformation and improvement, a transformation that, as it happens, can be conveniently brought about through consumption of enough of the current product range (Bigum *et al.*, 1993:44).

Re-inventing a product with which schools are unfamiliar is a relatively simple task. It typically takes on the guise of familiarising schools with the technology and its educational attributes, tapping what are now deeply ingrained anxieties about a highly uncertain but definitely high technology future. In a real sense, the new information and communication technologies offer a certainty of being a part of a future in which the only thing certain is computers and their associated technologies. It can be expressed in a kind of equation that says: *Schools + Computers = Less Uncertainty* (Bigum *et.al.* 1993). It represents a way of managing the complexity and uncertainty of "the future". In such an account it is important to keep the other variable in the equation, schools, as constant as possible. If the new information media are to transform schools to a less uncertain state, then schools need to be seen in a particular and almost constant state of low, or at least lesser, technology:

One of the TV advertisements run by Apple last year shows a girl walking through a dark, bare, old classroom to a Macintosh on a bench. She receives her enlightenment, literally, by turning the computer on. The advertisement would lose much if the girl had to walk past of rows and rows of well-lit computers being used enthusiastically by other children (Bigum *et al.*, 1993:44).

The computer is also presented as a solution for one of the most fundamental and perennial problem in education: how to tailor teaching to individual pupils' needs within a system of mass schooling:

The computer has, talisman-like- inspired faith in its ability to individualise the learning process in people who hold different educational philosophies. It is also a good example of the kind of technological package mass produced and widely disseminated -like automobiles- which has particular attractions for national governments looking for 'magic solutions' (Somekh, 1993:9).

Beyond the crucial issue of the economism/ vocationalism evident in recent educational policy[33], surveying the vast array of literature that is available today on computers in education reveals that there is a great deal more disagreement than consensus concerning the optimal purposes and uses of computers in educational contexts. This conflictual intellectual terrain, it turns out, poses significant problems for both researchers and for practitioners as their respective problems, though rather different, are importantly related. Presenting an analysis of the discourses of educational computing in terms of modernist, critical and postmodernist narratives which attempt to tell "true stories" of how and why new technologies are to be harnessed in the service of educational ends (and about the prospects and pitfalls therein), Bryson & De Castell (1994) demonstrate that the field of educational technology is populated by various teams who are telling altogether different 'true stories', each having quite different settings, characters and plots, with very different impacts for both *educational outcomes* and for *appropriate relations*:

But they are telling these very different stories, it is essential to note, about the very same technology. Thus, it becomes important to discover which tales are told in which classrooms, and how student computer use is accordingly delimited, as much as it is important to discern what is -and dangerously so- common to all these accounts. As Foucault suggested, the purpose of theorising is not to answer questions about truth and rightness, but rather, to ask *how things could have come to be this way*, and to try to discover, at any given moment, wherein lie the greatest dangers within the various discourses which are accepted and made to function as *true* (Foucault, M., Power/Knowledge, Pantheon Books, NY, 1980) (Bryson & de Castell, 1994:215).

4. A survey of sociological literature on IT in education. In addition to the sociological literature on IT in education registered so far in this chapter, some other important contributions must be acknowledged here. Referring particularly to the UK context, Young's (1984) seminal paper on IT and the sociology of education (already referred to in Chapter One) argues that a sociological analysis of technology would involve at least two closely related elements -the social organisation of labour involved in its production -and the way technologies as commodities are used to realise particular purposes. Along these lines, Young urges sociologists of education to raise questions not just about how teachers might use IT to aid what they do, but how in using such technology teachers are part of a complex multinational division of labour with its constraints which are social and technical:

Good sociological research will not produce anti-technology arguments, but will highlight ways in which we may be able to explore the social character of the technology. In doing so it could help us to raise fundamental questions about our work as teachers...in other words we need to examine the significance of the cultural specificity of the technical social distinctions that are part of our culture (Young, 1984:209).

In his more recent work on the sociology of technology, Young (1991) has suggested that a critical approach to technology literacy can also be usefully applied to IT in education. For Young (1991:234), technology is the most human of phenomena and is intimately involved in all spheres of social life. Therefore, he argues, it is simply not possible today for a democratic society to allow its citizens to remain ignorant of how technological decisions shape and are shaped by social purposes:

> ...how technological choices are enmeshed organisational, economic and political choices...a concept of Technology as a social phenomenon...we have to find ways of making explicit how different purposes are involved in its design, its implementation and its use, and how at each stage there are potential choices and decisions to be made. This means a technologically literate population and an increasingly wide debate about the content and meaning of Technological Literacy (Young, 1991:243).

In a similar line of thought, Matthews (1991,1992), has outlined some of the numerous social and political implications of IT in education, illustrating that the battle for cultural meanings is central to both education and information technology.

Linn (1985, 1991) has addressed cultural aspects of educational computing. In her early work, Linn (1985) identified "a conceptual and political paralysis" and a lack of serious critique surrounding new technology. Using Marx's notion of labour process she introduced a set of analytical concepts to show how this perceived crisis can be overcome in relation to the use of microcomputers in schools. In her later work (1991), Linn expands her earlier arguments exploring not only IT but technology in general as a social category.

Beynon & Mackay's *"Information technology into education: towards a critical perspective"* (1989) has been a seminal paper urging sociologists of education to develop the critical theoretical approaches and the appropriate research methodologies to address a number of crucial themes with regard to IT in education. Beynon & Mackay (1989) observe that the introduction of microcomputers into schools has not had a contested character, as is always the case with educational innovation, but it was rushed into with very little debate and the rationale of an "economic efficiency" model of education. For Beynon & Mackay, it is highly significant that IT in education has been developing at the same time as the broader restructuring of the education system:

In the attack on LEAs and teachers the debate on IT has faded to insignificance. Discussion of IT in education has focused on the technological, in a narrow sense; it has been neither theoretical or critical; and nor has it emanated from educationalists who, in this area as others, are in danger of being marginalised (Beynon & Mackay, 1989:255).

Beynon & Mackay (1989:245), maintain that at a micro-level, the consequences for teacher pedagogies and learning processes have not been assessed and that the implications have not been explored prior to the implementation of policy:

The vast bulk of the literature on IT in education...is prescriptive, uncritical and 'technoromantic'. Educational research on IT has hardly started to investigate what is happening in the classroom, and it lacks a critical dimension (Beynon & Mackay, 1989:246).

They suggest that there is a need for a paradigmatic shift from a narrow technical emphasis towards:

- ethnographic, classroom based studies of the uses of IT in education;
- studies to relate the IT into education phenomenon to the broader context of IT, the state and the economy;
- the development of a range of critical and analytical concepts as a move towards the development of a theory of IT in education, and as part of the sociology of technology;
- studies to deconstruct the rhetoric of IT in education and thus to inform teacher practice with a more realistic assessment of its strengths and shortcomings.

Apple (1992) has linked the introduction and use of IT in education to key questions about equality and cites empirical evidence in support of his argument that the growth of IT in education has led to an increase in educational inequality in relation to the "holy trinity" of class, gender and race. For Apple, technology, education and the use of IT in education are social phenomena which can never be viewed in isolation from the wider social context:

> School has always been an integral part of the wider society and a terrain of social conflict and ideological struggle, and the use of new technology in education should be viewed as part of this conflict (Apple, 1992:118).

From a Canadian perspective, Goodson & Mangan (1993) trace the genealogy of IT in education policy in Ontario since the early 1980s demonstrating in a powerful way that in the case of Ontario schools

> ... the rhetoric and the reality of educational computing have frequently reflected the conflicting priorities which normally condition state schooling, but that one tradition [the economic/ vocational rationale] has dominated all others in the ideological construction of classroom computing (Goodson & Mangan, 1993:263).

By analysing the introduction of computers as symbolic action, they show clearly that the economic/vocational rationale stands to be primarily promoted and they suggest that the introduction of educational computing may be seen as the latest phase in the recurrent attempts to vocationalise schooling, and to mould public consciousness to the view that education is predominantly about economic/ vocational preparation.

Somekh's research at the University of East Anglia (1993) has looked into the processes of educational innovation using as an example of curriculum development through the use of IT using an action research methodology. Deconstructing the rhetoric of the computer-as-talisman through an exemplary discussion of the "technoromantic rituals", Somekh discusses a range of implications of the introduction of IT in education: her discussion includes implications for teachers' autonomy and professional identity, for action research and educational knowledge, for the institutional context of professional learning and curriculum development, for IT as innovation in education systems and the role of individual values, for culture and ideologies in the process of institutional change. Somekh suggests that there will be little fundamental improvement in the quality of learning until there is a fundamental change in the structure of schooling, and that despite their best efforts, teachers are constrained by the institutional and cultural context within which they interact with students. But she suggests that it is just possible that IT could bring about such a change:

> Because it is such a powerful cultural talisman, there is just a possibility that the computer could be the catalyst for a radical change in this context. As always the economic argument may prove ultimately compelling... (Somekh, 1993:300).

From a US perspective, Muffoletto & Nelson-Knupfer (1993) have provided an interesting collection of social, political and historical perspectives on computers in education (including contributions by Popkewitz, Yeaman and DeVaney) which sets out to unmask computer technology as a neutral, non-historical, and non-social object:

> We wanted to ask questions that situated computers and related technologies within a social paradigm. The computer, as we understand it, is more than an electronic machine. The computer is a socially and historically constructed object referring to a world view grounded in the efficient production, dissemination, and control of knowledge. It is a viewpoint located within a social, political, and historical landscape (Muffoletto & Knupfer, 1993:1).

All contributors raise serious questions about the social, political and economic implications of computers and related technological systems on schooling, teacher education, and educational reform, challenging the common sense thinking about educational technology as the result of a positivistic disinterested science and a non-social, non-political, non-historical practice. Taken as a whole, the strength of the book lies in its ability to directly focus the interdisciplinary expertise of its contributors on important epistemological, social, economic and political concerns that educators face daily as they struggle to understand the implications of computer technology in education.

With particular reference to the social construction of multimedia -but still with ideas applicable across the range of computer applications and related products in education- Bigum et.al (1993) provide a valuable 'actor-network' analysis of how the selling of computers and their related products to schools, in part, requires that the product is "reinvented" socially for educational purposes.

Having provided a very important piece of critical sociological work on IT in education already in 1992[34], Bromley's doctoral research at the University of Wisconsin-Madison (1995) develops a sharp language in an attempt to foster certain ways of viewing technology and its role in social relations, including education. Bromley argues that many common understandings of technology obscure how it both affects and reflects the surrounding social conditions and that all too frequently we act on the implicit assumption that technology is a "neutral tool" whose impact depends wholly on the ends to which it is applied, or that it is an implacable external force, autonomously driving the rest of society in one direction or another. Bromley opposes such conceptual and rhetorical habits in favour of an understanding which highlights the deep entanglement of technologies with power, as exercised along multiple axes. Thus, drawing primarily on the field of educational computing for examples, Bromley explores:

...how the introduction of new technologies facilitates the maintenance and/or transformation of existing power relations, concentrating on those exercised along gender lines (Bromley, 1995:introduction).

5. Limitations of sociological literature on educational computing. The sociology of educational computing is still at an embryonic stage. Moreover, a significant part of this literature has remained preoccupied with studies of production and political economy -similarly to the overall tendency in the sociology of technology which I discussed in Chapter Two. Until recently, critical sociological literature still much echoed the concerns and preoccupations of the political economists of education and, indeed, the political economists of technology. By this I do not mean that studies of the political economy of IT in education are dispensable, quite the opposite is true; such accounts should be praised for situating IT in education within the global context of social and economic rivalries and transformations. However, this tendency to either ignore or, at best, infer "consumption" has inhibited the conceptualisation of IT in education as a process which does not stop after the production of technological products and their introduction into classrooms.

Beyond the preoccupation with the political economy of computers in education, the way in which critical sociological studies have treated IT in education has not been particularly useful for its conceptualisation as a social category. At a first macro-level, some marxist writers (for example, Olson 1987; Chandler, 1990) in their discussion of IT in education seem to have been trapped within a technological determinist framework which tends to discuss the "social effects" of a constituted technology. Also, some critical writers (i.e. Noble, 1984) tend to employ a rather limiting concept of ideology when arguing about the social effects of computers in education and "computer literacy" forms, a model of primitive marxist "conspiracy theory" describing the introduction of IT in education as a massive orchestrated deception (false consciousness) which serves particular interests. At a second level of policy critique, some critical accounts assume an extreme social determinism to fight the technological determinism of policy makers in education. This results in the total rejection of IT in education which denies the possibility of an appropriation of IT for radical purposes (i.e. Robins & Webster, 1989); there is also a serious lack of critical sociological literature to discuss the introduction of computer applications and products in classrooms as innovations related to the organisational culture of schools. At a micro-level, there are hardly any empirical studies of the "consumption" of computers in classrooms as "texts" interacting with the everyday life and experiences of individuals and/or groups within the school environment.

The shortage of theoretically informed critical sociological studies can largely be attributed to a serious lack of interdisciplinarity; only few critical sociologists of education have been bold enough to start exploring an unfamiliar field. This lack of interdisciplinarity has in some cases resulted in a tendency of some critical sociologists of education to write about computers in education in a journalistic style, that is without understanding much about the object of their writing. For example, this limitation is evident in the failure of some writers (e.g. Davy, 1984) to distinguish between the way the computer works and the way it is used:

> It is a popular assumption among these writers that the computer -by its very nature- carries with it particular (and undesirable) pedagogic practices. Such accounts almost always ignore the settings in which the computer is employed, the social interactions among children, computer and teacher, and broader questions of the nature and purpose of the computer's presence in the educational arena (Noss, 1992:4).

The preoccupation of the majority of critical sociological accounts of IT in education with macro-concerns, has resulted in a tendency to assume a passivity of users, to ignore the nuances of the context of "consumption" and to assume a passive, homogeneous audience or, at best, an audience stratified by traditional class divisions only (e.g. Persell & Cookson, 1987). Such accounts have tended to rest on the assumption that students are inherently uncritical and mystified. This approach has underestimated the extent and the diversity of children's existing knowledge about IT, has effectively ignored the social relations of the classroom, and has also ignored the nature of schools and classrooms as social organisations that both influence the way in which any new technology will be adopted and are influenced (sometimes in unanticipated ways) by that technology (as is illustrated thoughtfully in Schofield, 1995, for example[35]). Despite the existence of seminal writings like those by Beynon & Mackay (1989) and Young (1991) who give an active role to pupils resisting dominant definitions of the technology "text" which comes to be used in a classroom, part of the sociological critique of IT -like several theories of critical pedagogy which claim to speak on behalf of the oppressed- has tended to evade the complex and difficult realities of schools as complex organisations.

6. The cultural studies perspective. Recent sociological writings on educational computing come from significant "pockets" dispersed around the globe where scholars still struggle for conceptual and theoretical clarity. Although there has been a shortage of high-standard theoretically informed empirical research in the field, it seems that the cultural studies perspective has gained ground internationally[36].

A significant "pocket" of scholars (although not explicitly subscribers to a cultural studies approach) has been developing around Deakin University's Centre for Studies in Information Technologies in Education seeking to build a bridge between the sociology of education and cultural and media studies, and to develop a sociological language for talking about the implications of technologies in education (e.g. Bigum & Green, 1993; Kenway *et al.* 1996). Overall, the group seems to have adopted a loosely postmodernist view of the interconnections between media, educational technology, culture, subjectivity and schooling[37]. Green & Bigum (1993) argue that the implications of the new information technologies as new intensities of media culture have only recently begun to register in mainstream educational theory and practice. They suggest (1993:119), that this can be usefully considered in terms of the relationship between education and postmodernism. They advance the hypothesis that quite different youth and student subjectivities are currently forming out of the relations and practices of the new information technologies, and hence radical shifts are required in the social and educational imagination regarding young people, schooling and popular culture. Green & Bigum (1993:120), theorise the contemporary framing of youth as one of striking complexity and contradiction, youth as a field of diverse and contradictory practices, experiences, identities and discourses. For them, the social and discoursive construction of youth involves a complex of forces, including but not at all limited to the experience of schooling. Drawing on work by Grossberg (1988), Ellsworth (1990), Giroux (1992), Hinkson (1991), Hayles (1990) and others, they explore the role of media culture in the life-worlds of young people and the relation between this and their schooling. They argue that a new relationship is currently being constructed between schooling and the media, as traditionally understood and there is thus a need for educators-teachers, researchers and policy makers to take into account the larger educational and cultural context which exists outside the formal schooling system[38].

A more explicitly focused cultural studies approach to IT in education has been adopted by a number of scholars mainly based in the UK (e.g. Beynon & Mackay 1992, 1993). Drawing upon some of the work on cultural studies of technology which I discussed in the last part of Chapter Two, Beynon & Mackay have been at pains to demonstrate that a similar cultural studies framework can be applied to the study of IT in education and to develop a sociological language for discussing technology in education as a form of "text". The authors argue that developments in media and cultural studies are useful resources demonstrating how a range of texts other than the literary can be "read". They suggest that technology - including hardware and software- could be usefully analysed in a similar cultural and semiotic way:

> To apply the analogy to technology means starting with [the] assertion that it can be treated as a 'text' and, therefore, can have its meanings and values rendered visible and 'readable'. It is interesting that Johnson (1991) suggests that models of literary criticism which make explicit the tacit dimensions of culture could provide guidelines to the development of software evaluation. We would agree with that and point to the modes

of 'reading' a range of contemporary texts developed within cultural studies... over the last decade in the UK as a valuable resource... Such a reading covers both soft and hardware, as well as the context of implementation and usage, and it is far more far-reaching than Johnson's 'software evaluation' (Beynon, 1993:222-223).

In the light of this valuable conclusion, it is very odd that Haddon's (1989; 1991) study of the production, marketing and appropriation of the BBC microcomputer (discussed in Chapter Two) -although it has explicitly appropriated a cultural studies approach- has not addressed the implications of the BBC micro as a cultural artefact in education. Given that the BBC microcomputer was mostly used in British schools rather than at home (in 1984 73% of all primary schools and 78% of all secondary schools in the UK had BBC microcomputers with numbers increasing later), it would have been more than appropriate if Haddon's study had looked at the social processes involved in the introduction, marketing, use and appropriation of this technology in schools. Discussion of the Logo versions (software) used in British schools in Chapter Seven of this thesis will illustrate the social processes behind the choice of the BBC microcomputer as the "standard" hardware prescribed for British schools in a relentless game of power, politics and economics, the legacy of which is still left over to British schools today. That discussion will also illustrate the various ways in which Logo and its carrier hardware (mainly the BBC micro) were struggled over within an increasingly conservative educational context. This point is another example of how this thesis comes to point to the limitations of existing literature and fill significant gaps within it.

7. Conclusions. Our sociological understanding of the computer-based "educational" technologies has not evolved at a pace commensurate with the rate of evolution of practice. This sociological impoverishment of the field and the lack of an adequate theoretical perspective has certainly inhibited the development of research on the social and cultural implications of "educational" hardware and software all the way through -let alone the development of informed policy. Within this dissipation, it is not satisfactory to work from a theory base which regards the learner as a -more or less- passive recipient of "messages" delivered by the computer. As I have shown in Chapter Two as well as in this present chapter, it is only recently that the recognition of the active role of the learner in constructing his/her own meaning from an event or object is becoming commonplace in studies of technologies. I have pointed to a number of studies which stress that televisual media, computers and communications technologies should be seen as components in a complex process of interaction involving the learner, the media and their social context(s). Theorists in the field of cultural studies have recently developed theoretical and analytical tools testing their explanatory power with empirical studies putting due emphasis on "consumption" and appropriation of technologies. In terms of televisual media, for example, (and despite the constant resurgence of the simplistic thesis that broadcast media -particularly television- have direct effects on viewers) media researchers are well aware today of the complexity of the processes through which television programmes are interpreted (Moores, 1993; Buckingham, 1993; Haddon, 1994). In this domain, the question is shifting radically, from "What is television doing to children?" to "What are the children doing with television?" The question, therefore, is very interestingly shifting to a direction in which the sociology of technology had -in general- failed to look, that is the subjective, social appropriation of technologies. It has been emphasised in Chapter Two that the way in which technologies come to be actively appropriated by their users has been neglected for a long time:

> People are not merely malleable subjects who submit to the dictates of a technology: in their consumption they are not the passive duppes suggested by crude theorists of ideology, but active, creative and expressive -albeit socially situated- subjects. People may reject technologies, redefine their functional purpose, customise or even invest idiosyncratic symbolic meanings in them. Indeed they may redefine a technology in a way that defies its original, designed and intended purpose. Thus the appropriation of a technology is an integral part of its social shaping... However, the appropriation of a technology cannot be entirely separated from its design and development: technologies are designed for particular purposes. *How does the encoding of design interact with appropriation*? (Mackay & Gillespie, 1992:698-99).

Beyond, however, the potential usefulness of recognising "consumption" as an important stage, it seems that -as discussed in these two chapters- a large part of the cultural studies writings on technology stresses its concern with "consumption" and appropriation rather than with all the stages in the life-cycle of a technological artefact. In this sense, cultural studies has been as limited in its emphasis on "consumption" and appropriation as the sociology of technology has been in its emphasis on production. Therefore, it emerges as the common argument of chapters Two and Three that an appropriate cultural studies approach is needed which will not simply substitude "consumption" for production as its primary focus, but will address all "moments" in the life of the particular technology under discussion, paying due attention to the social processes involved at the moment of production, to the product's advertising and marketing, as well as to the social context of use. Chapter Four will now suggest that the "cultural circuit" perspective developed by Richard Johnson (1986) at the CCCS provides a useful analytical framework. This chapter will discuss variations of Johnson's model and will outline the research agenda for the analysis of Logo as a case-study to unfold in Chapters Five through Nine.

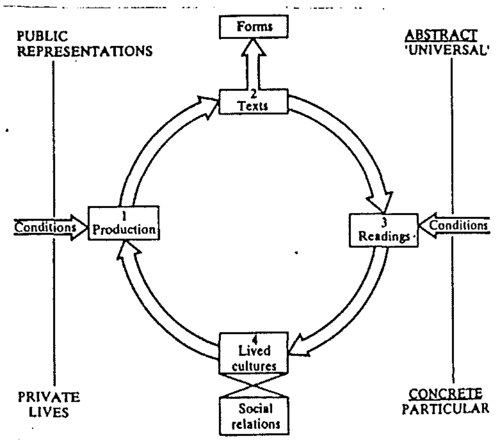
CHAPTER FOUR

A "circuit of culture" framework for the analysis of Logo

1. The circuit of cultural production. In a paper entitled "What is Cultural Studies Anyway?", Johnson (1983) provides a seminal account of cultural studies[39] and maintains that all social practices can be looked at from a cultural point of view. He defends the departure of cultural studies from the individualistic barriers of existing academic disciplines in favour of "a collective project different from the usual academic purposes" (1986:279). He argues that cultural processes are so wide that they do not correspond to the contours of academic knowledges as they stand; rather, he understands each approach as telling us about one small aspect of a larger process without grasping the full complexity (or seriousness) of the study:

> Cultural studies must be interdisciplinary or a-disciplinary in its tendency. Each approach is theoretically partisan, but also very partial in its objects... we need a special kind of defining activity which reviews existing approaches, identifies their objects, their good sense, but also their limits. Actually it is not a definition in the sense of an academic codification of cultural studies that we need, but *some pointers to further transformations*. This is not even a question of aggregating approaches -a bit of sociology here, a spot of linguistics there- but of reforming different approaches in relation to each other (Johnson, 1986:279-80).

Based thus on the hypothesis that existing theories and the modes of research associated with them express incompletely different sides of the same process, Johnson seeks "to explain the theoretical and disciplinary fragmentations of cultural studies as a whole" (Johnson, 1986:283). For this purpose he suggests an analytic "provisional description of the different aspects or moments of cultural processes to which we could then relate the different theoretical problematics"; he suggests (1983:15) that we can view the various forms of analysis within cultural studies as addressing different stages (or "moments") in the *circuit of cultural production* represented in the following diagram:



From Johnson (1986:284).

The model suggests that the life of a cultural product can be analytically viewed as the circuit of the production, circulation and "consumption" of this product, divided into four analytically distinct phases (or "moments"):

- moment 1: the conditions or means of material production;
- moment 2: the product itself as a "text" encoded with meanings;
- moment 3: the different socially-located "readings" or uses of a product;
- moment 4: the intersections of these "readings" with the lived experience of users.

2. Moment 1: from the perspective of production of cultural forms.

Johnson's analytic distinction between the four "moments" represents an equal number of approaches to cultural studies, each one of them giving primacy to the study of a certain aspect in the life of a cultural product. Each approach has tended to reproduce specific positions relative to the understanding of cultural processes, each with their own tendencies to intellectual imperialism. With regard to moment 1, Johnson identifies a tradition of writers who focus on the social processes involved in the production of cultural forms, the studies which focus on how and why cultural objects are produced. This is a particularly wide and heterogeneous set of approaches with very different political tendencies:

> I include here the knowledges of writers, artists, dramatists, media professionals and managers, advertisers, designers, experts in public relations, and, in their ideological tasks, professional politicians and administrators. But I include those theoretical and academic knowledges that look at cultural processes from a point of view which is bounded by the characteristic limits of vision of these groups. Liberal-pluralist theorists of mass communication, market researchers and public opinion pollsters and analysts take points of view closely related to the practical concerns of these professions...As between academic disciplines, it is social scientists [sociologists or social historians or political economists] who have most elaborately developed this perspective (Johnson, 1986:291).

For Johnson (1986:291), marxist paradigms clearly conform to production-based studies. Marxist theorists have been interested in cultural production from two related points of view. Firstly, they have been concerned to understand the specifically cultural resources of authority and the part which the organisation of cultural life plays in the reproduction of capitalist social relations. Secondly, they have been concerned to understand the relationship between revolutionary groups and parties and the lived culture of the subordinated social classes. They have taken the view-point of oppositional cultural producers, organisers of "counter-hegemonic" movements. Early marxist accounts asserted the primacy of production conditions, often reducing them to some fairly simple version of "the forces and relations of production". However, the forms through which culture or consciousness has been organised has been elaborated in later marxist accounts. In the work of Gramsci, for example, a production-based approach was greatly widened and marxism hugely enriched in both of its major preoccupations.

Johnson's evaluation points to two theoretical limitations of marxist analyses: the problems of *economism* and *productionism*. So far as economism is concerned, Johnson argues that there has been a tendency to neglect what is specific to the production of cultural forms, or the cultural dimensions and conditions of production generally. While he admits that analysis of the political economy of production is important and analyses of the institutional and economic considerations which shape the production are indispensable, Johnson emphasises the relative neglect of "cultural" production:

> Cultural production is assimilated to the model of capitalist (usually) production in general, without sufficient attention to the dual nature of the circuit of cultural commodities. ...the conditions of production include not merely the material means of production and the capitalist organisation of labour, but a stock of already existing cultural elements drawn from the reservoirs of lived culture from the already public fields of discourse (Johnson, 1983:27).

In his discussion of *productionism*, Johnson (1983:27) describes it as "the tendency to infer the character of a cultural product and of its social use from the conditions of its production, as though, in cultural matters, production determines all" subsuming all other aspects of culture under the categories of production studies. Johnson rejects this strict determination and denies this overemphasis on production and the ways in which conditions of production structure the product. He emphasises the perspective of interpretation and appropriation in the "consumption" of a cultural product.

3. Moment 2: from the perspective of texts. According to Johnson (1983:31), a second perspective of cultural studies research is chiefly concerned with treating cultural products -whatever their form- as "texts" with the intention "to provide more or less definitive readings of them". This kind of analysis of cultural products focuses on the study of form and content of products treating them as "texts" to be read. Artefacts here are analysed in order to explore the ways in which they construct a preferred "reading", a point which is perceived as a key strength of textual analysis:

> Cultural studies analysts focusing on this moment in the circuit may be showing the processes at work in films, in music, in visual art or in the form and content of a TV programme, as they pull out the elements within the text and discern the various layers of meaning which are operating. But textual analysis extends beyond these written, audio and visual texts. Political arguments and imagery, public rituals and clothing fashions have all been treated as texts to be interpreted[40].

Johnson argues that textual analysis of this kind has severe shortcomings, like the slippery formalist tendency to treat the text as an autonomous entity which is "read" in a certain way by the professional analyst. Johnson rejects this autonomy of the text from the social context. He de-emphasises the text metaphor and points out that by examining the text itself one can never gain useful insights as both author and reader are curiously excluded from analyses of signifying practices:

> Formalist textual analysis neglects questions of the production of cultural forms or their larger social organisation and also tend to neglect questions of readership or subordinate them to the competencies of a textual form of analysis... Formalist textual analysis with its structuralist semiological methodology tends to derive an "account" of readership, in fact, from the critic's own textual readings. Nonetheless, this limited account ignores the genesis of subjective forms and the different ways in which human beings inhabit them (Johnson,1983:37).

While the whole pressure of formalistic work is to isolate the text for closer scrutiny, Johnson says, the real tendency of the reading moment under everyday conditions is the opposite of this:

> The reality of reading, is intertextual, or, better, inter-discursive. No subjective form acts on its own; it must compete or combine for attention. Nor can we predict, in advance, from public texts in what combination of other elements it may appear to particular groups of readers. The logic of these combinations is not predictable from the public forms. It depends upon the cultural elements already in place in relation to the practical activities of particular social groups, and the long-term conformities between culture and situation. This includes the narratives of self which are already active, and the sense of individual and group identities (Johnson, 1986:299).

4. Moment 3: alternative socially-located "readings". In attempting to explain how subjects are produced, structuralist approaches stress the discursive or textual means. The key insight is that narratives, images or ideologies in general always imply or construct a position from which they are to be read. However, the inability of formal description to account for the complexity of "cultural texts" is partly compensated for by studies which highlight the "readings" of texts. This third cluster of approaches to cultural studies focuses on how people from different social backgrounds interpret cultural forms.

I have shown in the last sections of Chapter Two that a central theme of writing within cultural studies has been that although the "text" may have been devised (or "encoded") to contain certain ("preferred") meanings, those interpreting the "texts" do so against a background of their own previous experiences. Hence, an audience can derive meanings which were not necessarily intended by the designers/producers of a product. This means, for example, that when a cultural object is a physical artefact users/consumers may use it in ways unanticipated by the manufacturers (*appropriation*). Thus, studies of this category provide an account of the alternative reading positions offered in a "text", whatever its form. Yet, such a speculative analysis still infers the subjectivities of the "readers", without additional and different forms of inquiry into the more private. Percy registers this limitation of the approach clearly in her argument that

While it may be illuminating to uncover the way in which particular layers of meaning are constructed, we cannot simply read off from this the meaning-making experiences of particular groups of consumers (Percy, 1991:181).

For Johnson, the moment of “reading” is not only relatively more concrete, it is also more private. Thus, in reality textual materials become complex, multiple, overlapping and co-existent, they become "inter-textual" and their complexity stems from the social locations, history and the subjective interests, from the private worlds of individual readers. Therefore, a certain reading is never independent from the particular social milieu:

> All this points to the centrality of what is usually called "context". Context determines the meaning, transformations or salience of a particular, subjective form as much as the form itself (Johnson, 1983:42).

5. Moment 4: ethnographic studies of lived cultures. This fourth approach to cultural studies research privileges the fourth moment in Johnson's circuit, the stage where all the previously analysed elements or features come together and intersect with the existing reservoirs of experience. Here culturalist researchers stress the importance of interpretation, of the subjective interpretive activities of individuals and social groups. They try to take actual “readers” into account and study their individual experience of the whole circuit. These analyses examine the daily experiences of particular individuals or social groups which forms the background against which these individuals or groups interpret "texts" (for example the educational, work and leisure experiences of young working-class boys studied by Willis, 1977; 1980) attempting to account for the constant transformation of this experience caused by its reciprocal influence with the cultural form. For Johnson (1983:44), the problem here is on how to grasp the more concrete and more private moments of cultural circulation. Ethnography is suggested as a useful method[41].

6. The Mini Metro example. The cultural products (or "cultural forms", or "cultural objects") which move around Johnson's circuit constitute the focus of study and serve as case-studies in the sociology of culture; Logo will be such a case-study used in this project, it will be spun around a similar "circuit". Past examples of cultural products which have been researched have already been mentioned in Chapter Two including TV soap operas (e.g. Buckingham, 1987, 1993), public discourses about law and order (e.g. Hall, *et al.*, 1978), youth subcultures (e.g. Willis, 1977, 1979), the BBC microcomputer (Haddon, 1989), the "consumption" of satellite TV (Moores, 1993), the SONY Walkman (du Gay *et al.*, 1997). Johnson's model was never intended to provide specific guidelines for analysing technology as a cultural object; rather, his analysis constitutes an attempt to provide a broad schema for conceptualising the scope and methods of cultural studies. As it happens, however, the concrete example which Johnson originally took in order to illustrate this circuit diagram and in order to emphasise the symbolic dimensions of artefacts was itself a piece of technological hardware. "We can," Johnson (1986:285) says rather playfully, "whizz a Mini-Metro car around the circuit":

> I choose the Mini-Metro because it is a pretty standard later twentieth-century capitalist commodity that happened to carry a particularly rich accumulation of meanings. The Metro was the car that was going to save the British car industry, by beating rivals from the market and by solving British Leyland's acute problems of industrial discipline. It came to signify solutions to internal and external national threats. The advertising campaigns around its launching were remarkable. In one television advert, a band of Metros pursued a gang of foreign imports up to (and apparently over) the White Cliffs of Dover, whence they fled in what looked remarkably like landing-craft. This was Dunkirk in reverse with the Metro as nationalist hero. Certainly these are some of the forms -nationalist epic, popular memory of World War II, internal/external threat- that I would want to abstract for further formal scrutiny. But this raises interesting questions too about what constitutes a "text" (or raw material for such abstractions) in these cases. Would it be enough to analyse the design of the Metro itself as Barthes once analysed the lines of a Citroen? How could we exclude the adverts and garage show-room displays? Shouldn't we include, indeed, the Metro's place in discourses upon national economic recovery and moral renaissance? (Johnson, 1983:18).

Johnson's discussion highlights the way in which the Metro as a cultural object consists of far more than just a physical artefact: in particular, the approaches of cultural studies are sensitive to the symbolic meanings of such commodities; that is, these objects can also be read as "texts". In fact, it might be more appropriate to consider the Metro cultural object as being constituted by an ensemble of interrelated "texts". Continuing the above passage, Johnson proceeds to the question of how these texts are "read" by various social groups, as opposed to the range of possible interpretations of these texts which professional analysts could derive. He argues that there is not a single, predictable interpretation of a "text" like a popular representation of the Metro but, rather, a wide range of different socially-located "readings" are possible depending on the previous experience and cultural location of "reading" individuals and/or social groups (moment 3):

Supposing that we answered these questions affirmatively... there would still be some unopposed questions. What was *made* of the Metro phenomenon, more privately, by particular groups of consumers and readers? It would be unwise to infer this from public representations. For one thing, we would expect great diversity of response. Leyland workers, for example, were likely to view the car differently from those who only bought it. Beyond this [these readings], the Metro (and its transformed meanings) found some kind of lodgement in the ways of life and subjectivities of those groups for which it had a salience. It became a way of getting to work or picking the kids up from school. But it may also have helped to produce for example orientations towards working life, connecting industrial "peace" with national prosperity (Johnson, 1983:18).

Here Johnson is emphasising how "consumers" or "audiences" are not passive in their interpretation of texts or in their use of artefacts, but produce meaning for themselves. The lived culture experienced by different people (moment 4) is structured by the social relations of class, gender, race, age, etc. and other divisions and influences within their context. In Johnson's example, working for British Leyland would be one factor which might well shape the way in which employees "read" these "texts". Meanwhile, Johnson's last point illustrates the way in which this cultural production is indeed a circuit. He gives the example of how "readings" can then enter into and become part of lived culture, reinforcing or changing orientations. We might, in addition, broaden his point away from the emphasis on "texts" by suggesting how artefacts like Logo entering the school classroom can be used in such a way as to promote new patterns of social relations, or perpetuate existing ones.

Finally, the circuit is complete when lived culture provides some of the new "raw" material for further production. Although this theme is not developed in the quotation which has been selected here, Johnson later argues how producers are also engaged in the process of "reading" cultural practices -through such means as market research- and of drawing on elements from these experiences when constructing further "texts" or new versions of these "texts":

> Then, of course, the products of this whole circuit returned once more to the moment of production -as profits for fresh investment, but also as market researchers' findings on "popularity" (capital's own "cultural studies"), and as a stock of public and private meanings. The subsequent use, by British Leyland management of similar strategies for selling cars and weakening workers suggests considerable accumulations (of both kinds) from this episode. Indeed, the Metro became a little paradigm, though not the first, for a much more diffused ideological form, which we might term, with some compression, "the nationalist sell" (Johnson, 1983:18-19)[42].

When conceptualised within this framework, cultural objects entail far more than the "products" referred to in the economics and technology literature. In the latter -as I have argued in Chapter Two- a "technological product" is usually considered to be merely a physical object, a "black box", or a gadget. In contrast, we can derive from cultural studies a broader definition of what constitutes a product and of who count as being producers.

The car-as-a-physical object can be scrutinised as a text at the level of industrial design. What is neglected in Johnson's account is the way in which features of the Metro's very operation, the way it functions and its facilities, are also elements of the car-as-text. We should not lose sight of some of the traditional design concerns within the technology literature, such as questions concerning which features are prioritised in technical development. With this distinction in mind, a good part of Chapter Six (as well as parts of Chapter Five) will discuss Logo-the-language-as-a-text; I will argue there that Logo's technical/structural design consciously reflected ("encoded") the priorities of its designers as "preferred meanings" (cross-reference between moments 1 and 2).

Once we have adopted a broad conception of products and producers, a corollary is that "innovation" consists of more than those improvements which are introduced by R&D staff. There can also be innovation in terms of the other dimensions in the circuit. For example, when considering the introduction of Logo in schools (Chapters Seven through Nine) I ask what innovations were entailed when the initial small-scale experimental school-based use of Logo developed into larger-scale introduction in mainstream schools. As I will show, these innovations involved changes to the product across the board: in functions, in appearance, in the channels through which the product was marketed, in the very image of hardware and software companies themselves, etc.

7. Towards a study of the whole. The major contribution of Johnson's model lies exactly in its ability to theorise "moments" not as totally different, distinct or independent. For Johnson, cultural processes are complex and inter-discursive, and thus each one of the individual approaches within the circuit alone is inadequate to explain the complexity of determinations:

> But different social practices, of a more or less specialised kind, also inhabit the different moments: cultural production; cultural analysis; cultural consumption; and conscious practical activity in a broader sense (Johnson, 1986:285).

Johnson suggests that none of these "moments" is sufficient in itself though each may seem appropriate in particular circumstances when applied to particular objects. Johnson argues that there are dynamic transformations of cultural forms at each point around the circuit and, therefore, it would be preferable to find a way of holding all four instances together so that we can consider the transformations effected on the object as it passes between them. Therefore, individual approaches, each one with its limited rationality in relation to that moment it has most closely in view, are incompetent to handle the enormous complexity of cultural processes, they are inadequate as an account of the whole. As, however, each approach has its strengths and throws light on a particular aspect, Johnson argues (1986:307) that it is only with combined skills of this kind, not theoretical purism, that cultural studies can come to terms with the really important questions. What Johnson points to as a necessity is an adequate theoretical foundation which will become the unifying vehicle for a more adequate understanding of the inter-dependence of elements within and across "moments", a comprehensive conceptual category under which the complexity of cultural processes will be understood and explained in terms of its social-political function[43].

Not having attempted an ethnography or a social history of Metro drivers and "decoders" himself, Johnson sounds a little vague in his discussion of "moments". Yet, the model remains a fruitful one as it emphasises the "multi-accentuality" of artefacts as cultural signs. More detailed empirical work on transport technologies and consumption practices, carried out by two of Johnson's former students at the CCCS, helps to substantiate his points (see Willis, 1982, on subcultural meanings of the motorbike, and Hebdige, 1988, on uses of the Italian scooter cycle - the latter reviewed in the following section).

In my discussion of cultural studies approaches to technology in Chapter Two I have looked into Haddon's (1989) doctoral research on the cultural production and "consumption" of the BBC microcomputer as well as into other studies (mainly of television audiences) which have adopted a similar cultural studies perspective. In the remainder of this chapter I will refer to more studies which have appropriated Johnson's "circuit of production" with a view to derive a fuller picture of how the model could form the basis to the analysis of Logo as a cultural object.

8. The circuit of the Italian scooter cycle. In his social history of the Italian scooter cycle, Hebdige (1988) distinguishes between three rather than four "moments":

> ...there can be no absolute symmetry between the "moments" of *design/production* [1] and *consumption/use* [2] ...*advertising* [3] stands between these two instances -a separate moment of mediation: marketing, promotion, the construction of images and markets, the conditioning of public response. It is tempting when writing about design either to run these three moments together or to give undue prominence to one of them so that production, mediation or consumption becomes the "determining instance" which dictates the meaning of the object in every other context (Hebdige, 1988:80-81).

In terms of his moment 1 (*production*), Hebdige provides us with a concrete example of what a study of this moment might involve in his discussion of the Citroen DS-19 car [initially discussed by Barthes (1973) in *Mythologies]*:

We could trace the passage of the Citroen, then, from its inception/conception through the various preparatory stages: market research, motivational research, design - engineering, styling (division of labour within the design team; relationship of team to management infrastructure), modifications in conception at design stages, constraints of available technological resources on DS design, adaptation of existing Citroen plant to accommodate the new product, production of prototypes and models; production (labour relations, labour processes) ... distribution of finished product: retail arrangements, distribution of foreign licences, provision of servicing facilities, price, sales figures (consumer profile of target group)..., etc. (Hebdige, 1988:81).

Hebdige's narrative of the Italian scooter's *production* revolves mainly around the competition that emerged between scooter manufacturers in Europe in the years immediately after the Second World War. Guiding us through the development of 1946 Piaggio's *Vespa*, Innocenti's 1947 *Lambretta*, and other models, Hebdige illustrates a range of social processes involved in the production of these scooters, including the relative position of the companies in the global market:

In 1947, another scooter appeared which in its basic concept, scale and price, bore a close resemblance to the Piaggio prototype -the Lambretta produced by Innocenti of Milan. For almost 25 years, until Innocenti's scooter section was bought outright by the Indian Government in the early 70's, the Lambretta range offered the most serious threat to Piaggio's lead in terms of international sales and trade recognition. By 1950, Piaggio and Innocenti had between them opened up a completely new market for cheap motorised transport. Early advertising campaigns were directed at two emergent consumer groups - teenagers and women- neither of which had been considered worthwhile targets for this class of goods before the War. A new machine had been created and, inscribed in its design was another new "invention": the ideal scooterist -young, socially mobile, conscious of his or her appearance. The scooter was defined by a sympathetic journalist as "a comfortable, nicely designed little vehicle for people who do not care too much about the mechanical side of things" (Hebdige, 1988:90-91).

By 1951, Vespa's were being manufactured under licence in Germany, France and Britain. Innocenti had a factory at Serveta in Spain and the motorcycle company NSU held the licence for lambrettas in Germany until 1955. As the domestic market reached saturation point ..., Innocenti and Piaggio directed their attention towards Europe and the Third World. Ironically enough, when Innocenti were forced to sell their scooter operation in 1972 (.. because of industrial disputes), it was taken over by Scooters India, a state-funded project ... which still produces the "classic" lambretta models of the 60's. By 1977, Vespa were exporting 289,000 scooters a year to 110 countries (Hebdige, 1988:100).

Hebdige's discussion of the Italian scooter's moment 2 (*advertising/mediation*) is particularly rich. Drawing much detail from material (e.g. promotional films, advertisements, press releases, trade press reviews, etc.) put out during the 1950's and 1960's, Hebdige demonstrates how intensively the companies' advertising campaigns were constructing "selling" public representations of their products:

Fashion items appeared regularly in issues of *Lambretta Notizario*... A series of advertisements in the same magazine showed young women seated on scooters in a variety of contexts: the captions ran *"On a Pic-nic", "Shopping", "In the Country", "By the Sea", "In the Busy City"*, etc. A reciprocal effect is achieved through the elision scooter/girl: the scooter's versatility is used to advertise the freedom enjoyed by "modern" young Italian women and vice versa (i.e. look at all the places "she" can visit, all the things "she" can do). These two creations -the new Italian woman (an image fixed and disseminated internationally by the post War Italian film industry through stars like Anna Magnani, Silvano Mangano and Sophia Loren) and the new Italian scooter are run together completely in an article which appeared in the British weekly magazine, Picture Post entitled "A New Race of Girls" (5 Sept. 1954). (Hebdige, 1988:99).

And elsewhere:

These new horizons [international expansion and export] were inevitably translated into advertising imagery. During the late 50's, Innocenti ran a series of posters entitled "The whole World in Lambretta" which showed scooters posed against Buddhist temples or busy London streets. The caption beneath a photograph depicting a group of Ghanaian scooterists in "folk costume" invoked the then fashionable notion of youth/style -as-a universal: *"Wearing a continental suit or a native dress does not change young people's taste for scooters"*. It was through strategies such as these that Innocenti and Piaggio could appropriate new markets and convert them into visual capital (Hebdige, 1988:100).

In the final sections of his chapter on the Italian scooter, Hebdige (1988) collapses moments 3 and 4 of Johnson's circuit into a single moment 3 (*consumption/use*) in which he explores some of the "cultural meanings" which became attached to the scooter as it was used in Britain. Hebdige illustrates the ways in which the scooter became part of its owners' lived realities through a vivid discussion of the

50's and 60's *Lambretta* and *Vespa* use clubs in Britain and -perhaps more interestingly- through the intentional association of the scooter with the Mods sub-cultural life-style in the 1960's:

> During the mid 60's, Italian scooters became wedded, at least as far as the British Press and television were concerned, to the image of the mods (and rockers) -to the image of "riotous assembly" at the coastal resorts of Southern England...

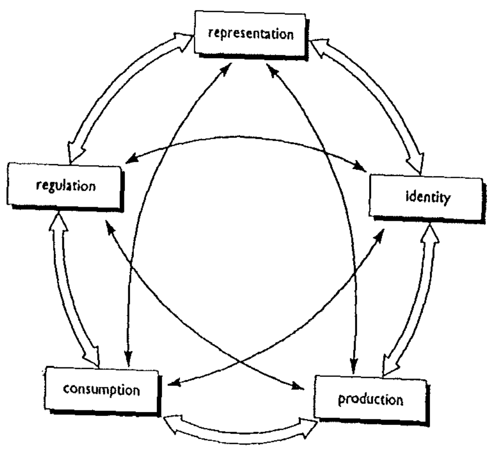
The Mod, a modernist youth sub-culture which emerged in or around London in the late 50's, was predominantly working class, male-dominated and centred on an obsessive clothes-consciousness which involved a fascination with American and Continental styles. The endorsement of Continental products was particularly marked. When the Italian scooter was first "chosen" by the mods as an identity-marker (around 1958-59...), says Hebdige, it was lifted into a larger unity of taste -an image made up out of sartorial and musical preferences- which in turn was used to signal to others "in the know" a refinement, a distance from the "rest" -a certain way of seeing the world:

> Value was conferred upon the scooter by the simple act of selection. The transformation in the value of the object had to be publicly marked: "*There was a correct way of riding: You stuck your feet out at an angle of 45 degrees and the guy on the pillion seat had his hands behind his back and leant back...*". Sometimes the object was physically transformed... Eddie Grimstead, who owned two scooter shops in London during the mid 60's, specialised in customising scooters for the mods. The machines were resprayed... and fitted with accessories: foxtails, pennants, mascots, chromium, horns, extra lights and mirrors, whip aerials, fur trim, and leopard-skin seats....
>
> the innovative drive within Mod, the compulsion to create ever newer, more distinctive "looks" was eventually to lead to another customising trend, one which, once again, seems to contradict the "logic" of the scooter's appeal. As the banks of lights and lamps began to multiply, a reaction set in amongst the "hard core" of stylists -scooters were stripped: side panels, front mudguards, sometimes even the footboards were removed, and the remaining body-work painted in muted colours with a matt finish (Hebdige, 1988:110-112).

9. The circuit of the SONY Walkman. In an exemplary study of the Sony Walkman as a cultural object, du Gay *et al.* (1997) also break with the logic that the mode of production of a cultural product is the prime determinant of the meaning which that product will or can come to posses. The authors identify five (rather than Johnson's four) major cultural processes *-Representation, Identity, Production, Consumption* and *Regulation-* which together constitute a sort of "cultural circuit" that can be used to structure the study of any cultural text or artefact. Putting this analytical model in practice, they analyse the biography of the Sony Walkman in terms of...

> ...a model based on the **articulation** of a number of distinct processes whose interaction can and does lead to variable and contingent outcomes.... Thus, rather than privileging one single phenomenon -such as the process of production- in explaining the meaning that an artefact comes to possess... it is in a combination of processes -in their articulation- that the beginnings of an explanation can be found (du Gay *et al.*, 1997:3).

The authors represent their model graphically in the form of the following diagram and explain:



The circuit of culture

> Taken together, they complete a sort of circuit what we term the **circuit of culture**- through which any analysis of a cultural text or artefact must pass if it is to be adequately studied (a similar approach has been developed by the cultural theorist Richard Johnson, 1986)... to study the Walkman culturally one should at least explore how it is represented, what social identities are associated with it, how it is produced and consumed, and what mechanisms regulate its distribution and use (duGay *et al.*, 1997:3).

Similarly to Johnson's theoretical discussion of the circuit, duGay *et al.* emphasise the purely analytic distinction between the five moments:

> Remember that this is a circuit. It does not much matter where on the circuit you start, as you have to go the whole way round before your study is complete. What is more, each part of the circuit is taken up and reappears in the next part... We have separated these parts of the circuit into distinct sections but in the real world they continually overlap and intertwine in complex and contingent ways (duGay *et al.*, 1997:4).

In their analysis of moment 1 in their circuit (*representation*- what I understand to be loosely an equivalent of Johnson's moment 2 -*text*) they indicate that meaning does not arise directly from an object, but from the way in which an object -in this case the Walkman- is *represented* in language, both oral and visual. In analysing the "establishment of cultural meaning through the practice of *representation*" they discuss the particular advertising texts which played a crucial role in fixing the meaning and image of the Walkman, linking the analysis of advertisements with the question of how various individuals, social groups, types of people and lifestyles came to be represented by or associated with the Walkman. That is, to questions about *representation*, they add that of *identities*, which is the second element of their cultural circuit:

> Here, the language of advertising is not so much a reflection of cultural identities which are already formed, as *constructing* identities through representation, by representing them in a certain way (duGay *et al.*, 1997:39).

Focusing on the third moment in their circuit, the *production* of the Walkman as a cultural artefact, they show how analysing the production of a cultural product involves not only understanding how that object is produced technically, but how that object is produced culturally; how it is made meaningful during the production process. In thinking about the *production of culture*, then, they are also thinking about the *culture of production* -the ways in which practices of production are inscribed with particular cultural meanings. This concern with the culture of production takes the authors back once again to questions of *representation* and *identity*, but also forward to questions of *consumption*: on the one hand, duGay *et al.* consider how the production of the Walkman was *represented* in distinct ways (as the activity of inspired individuals, as the result of the unique organisational culture of Sony and as a happy accident at work) and they examine the ways in which the *identity* of Sony as a company was continually created and recreated through these different representations, extending the earlier discussion of individual and group identities to that of corporate identities; on the other hand, duGay *et al.* highlight the ways in which the Walkman was "encoded" with certain meanings during its production process and how these were aimed at establishing an *identification* between object and particular groups of *consumers*. In particular, they focus upon the role of design in this process, exploring the ways in which designers attempt to bring together or "articulate" two key moments in the cultural circuit - *production* and *consumption*.

Subsequently, focusing their attention on the structure, strategy and culture of Sony, the authors highlight the company's ongoing attempts to become a "global" entertainment corporation. In particular, they focus upon the company's strategy of combining the production of cultural hardware -the Walkman and so on- with cultural software -the music that people play on their machines- to offer consumers a total "cultural" package. Once again, they highlight the *articulation* of *production* and *consumption* that this strategy of "media synergy" is designed to effect. They also point to the difficulties inherent in Sony's attempt to achieve such a close fit between production and consumption.

In what appears to me as the equivalent of Johnson's moment 3 (*readings*) duGay *et al.* go on to explore processes and practices of cultural *consumption* emphasizing that -as their notion of the "cultural circuit" suggests- meaning-making is an ongoing process which does not just end at a pre-ordained point:

> While producers attempt to encode products with particular meanings and associations, this is not the end of the story or "biography" of a product, because this tells us nothing about what those products may come to mean for those using them. In other words, meanings are not just "sent" by producers and "received" passively, by consumers; rather, meanings are actively made in consumption, through the use to which people put these products in their everyday lives (duGay *et al.*, 1997:5).

Finally, duGay *et al.* explore some of the effects that Walkman use had upon the *Regulation* of cultural life in modern societies. In that section, they locate the Walkman as one of the latest in a long line of technological innovations which has challenged traditional distinctions between private and public space. They examine the ways in which Walkman use breaks with established representations of public and private space and how its status as "matter out of place" -being both public and private at the same time and hence neither simply public nor simply private- leads to attempts by institutions to regulate its usage. They also indicate some of the ways in which these problems of *cultural regulation* have come to the attention of Sony and how they have impacted on the *design and production* of the Walkman.

10. The circuit of *Channel One*[44]. This last example of a cultural circuit perspective applied to the analysis of a technological product is directly relevant to school education and real classrooms and, therefore, is highly relevant to the study of Logo as a cultural product in education which is the focus of this thesis. Apple (1993, chapter 5) acknowledges explicitly the viability of Johnson's circuit of cultural production for sociological analyses of the encounter between education and technology in his discussion of the growth of *Channel One* in US classrooms[45].

Apple starts the exploration of what I would call "moment 1 in *Channel One*'s circuit" (*production*) by providing a picture of the political economy of *Channel One*, situating the material conditions surrounding the growth of *Channel One* in classrooms within the crisis in the economy, in ideology, and in authority relations. Apple demonstrates how the development of *Channel One* and its introduction into US classrooms has not been an innocent initiative motivated by genuine concern for the enhancement of pupil's education but, rather, a carefully planned deal between business and schools in the former's choice to colonise education in order to claim significant tax reductions from states and local communities within the context of a deepening financial crisis which has left schools prey to business and industry's aggressive advertising campaign:

> The example of Channel One demonstrates how a depressed economy, the discourse of crisis, and the concrete needs of schools create the conditions of existence for the creation of students as a captive audience. A business/school partnership is formed in which business gets profits and legitimacy while schools get equipment... (Apple, 1993:115).

Beyond the deconstruction of corporate interests disguised as generosity and concern for education and the demonstration of their allegiance with conservative restorational politics in education, Apple recognises that beyond material production and its context (moment 1), other "moments" in the circuit should also be catered for:

> Yet, the fact that these schools are now officially open to advertising's purview does not exhaust what should concern us. There is a cultural politics involved concerning the content and form of what gets broadcast to classrooms and what students and teachers do with it. The economics of the fiscal crisis and the struggle over it point to the material conditions surrounding Channel One's growth. These conditions are but one aspect of what Richard Johnson has called the circuit of cultural production of the commodity itself. Other aspects of production -the production of and struggle over *meaning* itself- are essential elements in the process (Apple, 1993:101, original emphasis).

In his discussion of what I understand as moment 2 in *Channel One*'s circuit, Apple is concerned with the text/content of *Channel One*'s transmissions and with the picture of the world which this "text" ("news" and commercials) construct in the eyes of the "captive audience". He argues that we need to analyse how television constructs a picture of the world, and how it makes sense of the real. For Apple, this will enable us to show how television hides its sense-making processes so that the viewer's attention is kept on *what* is shown, and not *how* it is shown:

> Many people have raised questions about Channel One's inclusion of commercials. It is evident from my arguments that I am deeply concerned. Yet, also at issue is *the news itself*. What will be "reported"? Whose news? Under what ideological umbrella? What do we know about what counts as news in general that should make us very cautious of Channel One's continuation of these tendencies, a continuation that becomes even more obvious the more Channel One is seen?... The form, then, that the news takes is critical. Equally important, however, is the content itself since both the content *and* the ways it interacts with the narrative form of news stories are crucial elements in constructing an "understandable reality" (Apple, 1993:103-4, original emphasis).

and

> ... we need to engage in the labor-intensive task of... examining the stabilities and transformations of what counts as news and the codes of its presentation over time on Channel One, constantly comparing it to other newscasts. Who are the "primary definers" of the news? Who speaks authoritatively and who does not? What are the recurring patterns, emphases, and images that constitute the discourse? How does the news change as the fortunes of rightist movements themselves change? (Apple, 1993:110).

In his discussion of *Channel One's* moment 3 (*readings*), Apple argues that we need to take the next step of theorising the work these encoded/preferred meanings of the *Channel One* televisual text perform in and on the viewing subject. In essence, he argues, this step asks us to examine (speculate on) the media's ideological work in helping to construct subjectivity and consciousness. Apple investigates how both the form and the contents of the technology are "read" by teachers and students in classrooms:

Channel One, of course, is aimed at someone. But is the "message sent" the "message received"? Is it possible that Whittle's Channel One serves the interests of the dominant and subordinated at one and the same time? Can it be read oppositionally or subversively? What do the vast range of students -defined by the contradictory dynamics of race, class, gender, sexuality, religion, and so on- actually *do* with Channel One? (Apple, 1993:110, original emphasis).

The answer Apple gives to all these essential questions could be summarised by the key-words *readings* and *appropriation*. He illustrates vividly how *Channel One* and its broadcast content are often "read", interpreted, and responded to in ways very different from the official expectations. Reporting research evidence on *Channel One*'s appropriation in classrooms, Apple gives examples of "readings" very different from what *Channel One*'s official sponsors would expect:

Ongoing research ... indicates that students often ignore the news content of Channel One. They often talk to each other while it is on, do homework, etc. *What they do watch is the commercials...* In many instances, the news was unimportant. Students and teachers used Channel One for different purposes... As one teacher from Texas put it, 'The best thing about it is the VCR. The kids and I basically ignore the news. But we can use the VCR in a lot of other areas (Apple, 1993:112, original emphasis).

and elsewhere

Channel One is seen by students and teachers inside classrooms... Television here does not stand alone. It is situated into the daily flow of classroom events... Of course,...neither students nor teachers will be passive "consumers" of what Channel One broadcasts. They will actively construct and reconstruct the meanings of what is reported while watching and listening to it. Nor will all of these constructions of meanings be the same. They will be a contradictory assemblage of responses based on the class, race, religion, sexuality, and age relations in which people are formed (Apple, 1993:113).

After moving away from the idea of television (or any "text") as closed (as a site where dominant meanings automatically exert considerable or total influence over its reader) in his analysis of moment 3 (*readings*), Apple argues that moment 4 (*lived cultures*) is the place to investigate deeper this variance between preferred/encoded meaning and appropriation. He argues that it is the moment where we ought to interpret this distance through a detailed study of the social realities and daily experience of users as individuals and/or as members of social groups. Apple argues that inside the classroom, *Channel One* is partly recontextualised and, as a result, while the content and form of the news largely conforms to dominant interpretations of the world, students and teachers partly mediate and transform it. These mediations and transformations are limited by daily classroom life, but they do exist:

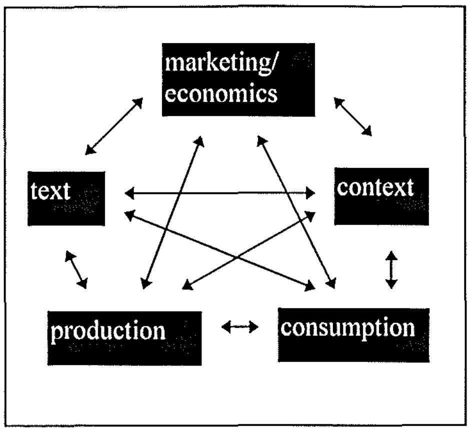
> Where are the gaps and spaces that open up television to meanings and reading strategies that may not be the preferred ones? The question is not the "effects" of television, but rather *how* a particular television work, seen as a polysemic potential of meanings, *connects with the social life of the viewer or group of viewers*. How is a "television text" created by the active reading of an audience? How does the process of common-sense making operate? (Apple, 1993:102, emphasis added).

Here, once again, we realise how fragile the artificial analytic boundaries drawn by the model between moments 3 and 4 (*readings* and *lived cultures*) are. For both Apple and Johnson, moment 4 (*lived cultures*) is the moment where the whole circuit is wrapped together and interacts with the daily/lived experience of a cultural product's consumers:

> ...the process through which students and teachers produce their own meanings about the "news" is complex. The social situation and material conditions in which it is watched may limit what meanings are created, but both students and teachers will not simply internalize "the message sent". The polysemic quality of the medium, the surplus of meanings available, the play allowed by the commercials, the lack of focus by students on the news itself, and the different readings that different students will make of all this, should make us sensitive to the complicated realities of cultural politics here (Apple, 1993:115).

11. Logo as a cultural object: a research agenda. This chapter has provided examples of studies which have adopted a "cultural circuit" perspective similar to that introduced by Johnson, and they have illustrated the potential usefulness of such an analytic model for the cultural analysis of a range of technological artefacts as cultural objects. Through the discussion of these studies alongside the discussion of Johnson's own model, significant parallels emerge which are vital to the study of Logo. It emerges that in order to study Logo culturally, one should explore at least: its context and processes of production; the preferred meanings "encoded" in the language by its designers; the processes of advertising, marketing and economic reasoning involved; the range of "readings" that variably socially- and culturally-located users make of Logo within their particular context(s) of use; last but not least, analysis should address the deeper (and more private) aspects of the deconstruction and appropriation of Logo by students and teachers as situated into their daily experience of schooling and the daily flow of classroom events within their particular institutional culture(s).

Apart from its insights, however, the studies discussed above indicate some of the problems and omissions in Johnson's circuit; considering these limitations, I believe that the five-moment circuit which I am going to propose here -drawing upon this work- is more adequate for the discussion of Logo as a cultural product in education. The following chapters comprise a "dossier" on Logo following a circuit of five "moments" instead of Johnson's four: ***production, text, marketing/economics, context, readings/consumption.***



The sequence of the narrative corresponds loosely to the progression of the object (Logo) from production/ design through marketing into use though there is a good deal of cross-referencing between different "moments". Also, the narrative follows a loose chronological order in the progression from production to "consumption". However, there are points where it was necessary that the rule of chronological order was broken in order to capture the complexity of articulation between the various moments.

Analysis in Chapter Five will provide an account of the social forces and processes involved in Logo's "production" (moment 1). Through reconstructed accounts of participants and secondary sources, Chapter Five will demonstrate the contingent and unstable nature of Logo as constantly changing and developing technology in the context of the decision-making processes. The early history of Logo will be chronicled with a view to showing that -far from consensual- the development of Logo has been an arena of struggle where social, political, commercial and interpersonal conflicts were played out.

Chapter Six will provide an analysis of Logo as a *"text"* (moment 2). The co-existence of the theoretical and the technical in Logo requires that any analysis of Logo as a "text" should take account of both Logo-the-language and the educational "philosophy" behind it, the two taken together as a textual "package". Looking into the first of these two elements, the first part of the chapter will argue that the social processes at the level of production have inscribed in Logo-the-language (through the particular choices over its technical/structural design) certain "preferred meanings" which reflect ("encode") the educational "philosophy", the ideological and epistemological assumptions of its developers. It will be argued there that the material form of Logo-the-language was consciously structured as a symbol, as a collection of signs which mirrored the ideas and expectations of its creators and was more compatible with and supportive of certain forms of use rather than others.

Looking into the fundamental epistemological principles and assumptions of the "Logo philosophy" for education (mainly as these are presented in Papert's *Mindstorms*), the second part of Chapter Six will locate the "Logo philosophy" theoretically within the tradition of "progressive" education. Given that *Mindstorms* has played the role of a paramount advertising means which largely fixed the image and meaning of Logo, I can identify a straight correspondence at this point between my argument for the necessity to analyse this aspect of "moment 2" and Johnson's observation highlighted in page 77: similarly to Johnson who argues that we cannot "exclude the adverts and garage show-room displays" from our discussion of the construction of the Mini-Metro as a cultural artefact, Chapter Six argues that we cannot exclude an advertising text like *Mindstorms* from our discussion of the construction of Logo as a cultural product in education.

Chapter Seven will provide a discussion of Logo's *marketing and economics* (moment 3). It will demonstrate that the activities of mediators like government departments and the domestic microcomputer industry were crucial to the modification and redevelopment of Logo beyond the context of its initial production.

After the introduction of *marketing and economics* (moment 3) which does not feature as a separate "moment" in Johnson's circuit, Chapter Eight presents another innovation: the existence of ***context*** as a "moment" in the circle of cultural production (while Johnson's equivalent -"conditions"- is left outside the circuit). I suggest that the inclusion of *context* in the circuit is very important because as Johnson himself has suggested:

> judgements ... cannot be made on the basis of the analysis of production conditions or texts alone; they can best be answered once we have traced a social form right through the circuit of its transformations and made some attempt to place it **within the whole context of relations** of hegemony within the society (Johnson, 1983:48, emphasis added).

The necessity of studying *context* as a moment is also evident in the following quotation from Rosen (1993):

> In order to understand the full extent to which an artefact can be seen as a 'sociotechnical ensemble', it is necessary to look not just at the internal dynamics of the technology, but to look at the same time beyond this to the wider social world in which they are located (Rosen, 1993:485).

Along these lines, it is necessary that Chapter Eight will provide a discussion of the changing social and political landscape at the time of Logo's introduction to mainstream US and UK education; what happened when Logo was lifted from the context of MIT and was taken to real schools, -and more importantly- *why*, will be the major questions asked here. It will be suggested that "restructuring" and the backlash against "progressive" education formulates largely the context in which the initial reception of Logo in mainstream schools in the early 1980s must be seen. I will argue that what the literature describes as the "pendulum swing" against Logo in the 1980s was largely a consequence of the conservative restorational politics in the education and society of both Britain and the US which eroded the basis of child-centred Logo-like approaches to schooling.

Beyond the discussion of the broader social and political context, it is of crucial importance to examine -at the level of "consumption" this time- the influence of the institutional context(s) within which Logo was inserted:

> It is a mistake to propose that the educational value of a programming language -or indeed any technological innovation- can be assessed by its epistemological features or that there is any causal linkage between a piece of software and a way of learning. Instead, we need careful investigation of the ways students use the computer, how it enters into the educational domain, and how it might structure and be structured by the classroom setting into which it is inserted (Hoyles & Noss, 1992:xix).

Building upon this discussion of *context* in Chapter Eight, Chapter Nine will illustrate how the introduction of Logo as an educational innovation has related to the organisational culture of schools and classrooms. It will show how within these cultures Logo was "read" and appropriated differently by different social groups and individuals in pursuit of their goals in their day-to-day lived experience of schooling, often ending up being "normalised", institutionalised and assimilated into existing practices. Chapter Nine will thus provide a window into the ways in which the social context of use and the pre-existing power relations in and around school settings where Logo was introduced tended to privilege "readings" of it which were more likely to reproduce rather than challenge the status quo. As a representative case illustrating the ways in which Logo was changed and largely "normalised" in the course of entering the educational world, Chapter Nine will discuss how the reading/appropriation of Logo as a device for trivial turtle graphics came to dominate the educational world.

Finally, Chapter Ten will summarise the findings of this study drawing together the main theoretical and methodological conclusions. In addition, Chapter Ten will propose a prospectus for an extended future study of Logo's moment 5 (*readings/ consumption*) which within the limits of this dissertation is not given the attention that it deserves. This is because it became obvious in the process of designing this study that such a wide-ranging analysis of Logo as a cultural object in education would be a mission much too ambitious to accomplish within the scope of one project, especially within the constraints of Ph.D. resources. As certain priorities had to be set and boundaries to be drawn, there has been a conscious decision to leave the in-depth ethnographic study of moment 5 outside the boundaries of this study as a commitment for the future.

12. Notes on methodology. The seeds for this research -which has been largely qualitative- go back to 1991 and my M.Ed. dissertation at the University of Stirling, Scotland, which involved a theoretical exploration in educational computing and a content analysis of content-specific educational software[46]. My move to the Institute of Education in October 1992 signaled the beginning of an expedition significantly wider in scope. The first year involved a thorough literature search and extensive reading in a number of areas: sociology and history of technological innovation (I have reviewed some of this material in

Chapter Two), cultural studies, sociology of education and educational computing. Although the "cultural circuit" approach had attracted my attention from the beginning, it was necessary that these other bodies of literature were also considered, even though engagement with some of these fields was never a central goal of the thesis. With the guidance of my supervisors, what was a frustrating first year of much reading and very little writing, ended with major decisions being made in terms of the working framework for the study as well as the methodology for it, while the decision to appropriate Johnson's "cultural circuit" model had already been made. These decisions were periodically reviewed until the research design was firmed up, the data collection completed and the data analysis well under way. The decision to involve Logo as the focus of the empirical research replaced an earlier decision to focus upon the theme of word-processing. Also, the decision to analyse Logo as a case-study in educational innovation meant that another round of extensive reading, this time on the processes of educational change as well as on the cultures of educational institutions, was needed.

At a first stage, research and data collection involved an analysis of a large body of primary and secondary literature which was found through literature search which included the journals listed in Appendix A. Literature search included the use of resources like the ERIC database, the British and Australian Education Indexes, the *Educational Technology Abstracts*, and the Bath Information & Data Services (BIDS) which provided access to the Science Citation Index (SCI), the Social Sciences Citation Index (SSCI), and the ISTP (Index to Scientific &

Technical Proceedings). I have also searched through back issues of *Wired* magazine on its Web site (http://www.hotwired.com/).

The extensive reading of published and unpublished material particularly on the history of Logo was a major part of my research and data collection, including a large number of issues of professional journals, newsletters, bulletins (for example, *Logo Exchange* and *Logo Update*) and other material, some of it dating back in the early 1980s. At this point I am grateful to my co-supervisor professor Richard Noss for allowing me access to his personal archives where I have found indispensable material which would otherwise be very difficult to find. Empirical data was also gathered through semi-structured interviews with the original developers of Logo (mainly academics based in the US) and other people who have been significantly involved in its evolution in both the US and the UK at different stages. These included interviews with Harold Abelson, Janet Ainley, John Berlow, Al Cuoco, Mike Doyle, Wallace Feurzeig, Paul Goldenberg, Ronnie Goldstein, Brian Harvey, Celia Hoyles, Uri Leron, Henry Lieberman, George Lukas, Richard Noss, Seymour Papert, Dave Pratt, Mitchell Resnick, Sherry Turkle, Bill Tagg, Dan Watt, Molly Watt, Uri Wilensky and John Wood[47]. Visiting BBN Educational Technologies Department, the MIT Logo Lab and other MIT departments, I also had the benefit of "hanging around" for a short period, quietly observing the distinct organisational cultures of these places. The limited resources available during my visit to the United States did not allow me to cross the country and interview Brian Harvey or Andy diSessa at Berkeley University, both of whom have been key-figures in the development and evolution of Logo. However, I had the opportunity to interview Brian Harvey soon after my trip during his visit at the Institute of Education. Although I had fixed appointments with my interviewees before I set off to the USA, I also had the opportunity to squeeze into my tight time-table interviews with people with whom I had not made an appointment beforehand, when the opportunity was there and/or when information suggested that their contribution to the data would be indispensable. This extra off-schedule activity required quick decisions and flexibility; one of my richest and most illuminating interviews (with John Berlow) started over the table of a quiet Chinese restaurant in Boston, an hour after a request was made over the phone! Also, a small number of telephone interviews were arranged and carried out.

At another stage, the research has involved data collection through classroom observation in British schools, discussion with teachers, analysis of video-taped classroom activity with Logo (including NCET's video-pack *Working Mathematically With Computers*) and analysis of classroom talk about work with Logo (including material collected by Celia Hoyles, Rosamund Sutherland, Lulu Healy and Stefano Pozzi of the Institute of Education for their *Groupwork With Computers* project).

Neither data collection nor data analysis have been one-off processes. While the study and analysis of existing material was still underway, considerable effort was made to develop functional versions of an interview schedule for the collection of primary data through semi-structured interviews. At the same time, travel arrangements were made and appointments with interviewees in the United States were fixed well in advance. Before the interviews in the States, however, the interview schedule was piloted with a small number of interviewees in Britain and a first round of analysis of the data collected took place. A second round of interviews in the UK took place a few months after the interviews in the United States.

Apart from the analysis of the interview data and literature sources, I have received -throughout my research- valuable assistance from a number of individuals from around the world, this time on e-mail. I have also used e-mail to obtain useful comments, clarifications and feedback from my interviewees on parts of the data analysis as well as for collecting complementary data.

My effort to combine theoretical perspectives from more than one strictly-defined areas, was assisted by the joint supervision which I enjoyed having two supervisors from two different departments (now "academic groups") of the Institute. Also, attending MA courses on offer around the Institute which were one way or another relevant to my research has helped a lot (like, for example, Michael Young's "Technology, Work and Education" course and Ken Jones' modules on Cultural Studies). In addition to the above, I have benefited enormously from exchanging thoughts with a number of the Institute's staff as well as visiting professors. On the practical side, having to read heavily on areas like the sociology and history of technology -which are not traditionally associated with education- meant that at times I had to work in libraries other than that of the Institute of Education, in libraries including those of the Imperial College of Science and Technology and the University College London.

With regard to quotations from interviews, in what follows I have the permission of the people I quote and, once again, I wish to thank them warmly for their co-operation. In fact, allowing the interviewees concerned to comment on the final draft of this dissertation was necessary in terms of research ethics as it had been agreed with some of them that they should not be quoted without their permission. As it happens, I have attributed most quotations; where I haven't it's because I judged that it was somehow sensitive. For the same reason, two of the interviewees are not named while the interviews with them have been classified as "unattributable". A list with the names of my interviewees is provided in Appendix B; it includes information on their current professional identity as well as the date and location on which each interview took place.

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CHAPTER FIVE

Social Processes in the Development of Logo

1. Introduction. Trying to understand the production of Logo does not involve simply recounting a story that takes us from inspiration in the design laboratory on to the act of "consumption" in school classrooms. Instead, it involves having to consider a number of different narratives and representations of the "facts" that have become associated with this technology. The different stories begin -and are perhaps most acute- when we consider the contrasting accounts of Logo's origins. Although the process of Logo's production itself has occupied minimum space in the literature, it is interesting that reading through the existing material on the history of Logo one is confronted with a dominant explanation for its origins which unproblematically privileges the MIT-based activities of a single individual (Seymour Papert), frequently referred to as the "inventor" or the "father" of Logo. Although Papert would be the first to acknowledge that Wallace Feurzeig has played an equal role in the development of Logo in the early days, in many books and articles Papert appears as a symbolic personification of both the technology (Logo) and the main research institution (MIT AI Lab) where research on Logo has been going on for almost thirty years[48].

IMAGE REDACTED DUE TO THIRD PARTY RIGHTS OR OTHER LEGAL ISSUES

What we are dealing with here is a very specific way of representing the origins of Logo. This is an explanation that links the life of one individual with the biography of an institution and an artefact. It is an approach to social life and history fre-

SEYMOUR PAPERT

quently to be found in newspaper articles and television documentaries. It is a model of history and social change explained as a result of the talents and "inspirational" activities of great individuals. This is the Logo story as a *narrative* of an individual life and an institution. However, it has become obvious in the previous chapters, that my approach in this project is somewhat different. Without wanting to devalue or underplay the leading role that an exceptional person like S. Papert has played in the evolution of Logo over the years, I seek to place such individual activities in a wider context of social and cultural processes.

Research evidence collected for this study suggests that there are a number of parallel views of the origins of the same technology (Logo). This range of collected accounts provides an insight into the contested character of cultural production and indicates how Logo has not only accumulated different meanings in marketing and among different groups of users (as I will illustrate in Chapters Seven and Nine respectively), but also amongst those who participated in its production. Moreover, to understand production processes we need to refer to more than the title of occupational roles (e.g. group leader, software engineer, mathematician, teacher, etc.) and definition of specific activities of individuals. We need to try to understand the distinctive practices used in the production of Logo and the way that such practices represent *specific values*, beliefs and patterns of working, what duGay *et al.*(1997:43) call the "culture of production". In approaching the production of Logo we need to understand the distinctive ways of life -the cultures- within which Logo came to be constituted as an idea, and then manufactured and marketed in a particular way. In the initial development of Logo, more than one organisational cultures of production was involved.

2. The development of Logo at BBN. As Appendix One indicates, Logo was initially developed at a time of enormous support to the development of mathematics and science teaching methods and curricula: in the post-Sputnik years of technological racing against the Russians. Within this context of enormous financial investment in technological development as well as in science and maths education, Logo -unlike most other programming languages- was specifically designed for education. The initial research about what was to become Logo goes back to 1966 and it was carried out by a research team at the Educational Technologies Department of BBN, a Research & Development company in Cambridge, Massachusetts. The initial research group was pretty small including people who later faded out. Wallace Feurzeig was the group leader. Daniel Bobrow, Robert Lawler[49], Cynthia Solomon[50] and Seymour Papert were among those involved. A quick reference to some of the distinctive characteristics of BBN as a company is useful for our understanding of its "culture of production" and its relation to the initial development of Logo.

2.1. Pre-Logo work at BBN. BBN was founded in 1948 by three MIT acoustics professors -Richard H. Bolt, Leo L. Beranek and Robert B. Newman. All three had been involved in military acoustics research (e.g. submarine noise quieting) during the war. After the war the focus of research at BBN was still very much in the field of acoustics and psychoacoustics, the study of the psychology of noise reception. BBN contracts included industrial noise quieting, the acoustics design of theatres and concert halls (like the Sydney Opera House), jet engine noise quieting for the Air Force and submarine noise quieting for the Navy. BBN has also conducted analyses of recordings of the rifle shots that killed J.F. Kennedy and of the Nixon tapes. In more recent years BBN has focused much of its work on computer-based communications, most notably the development and servicing of ARPA's (Department of Defense) *ARPA-net*, the precursor of the Internet.

In the early 1960s BBN had become a major centre of computer science research, technological development and innovative application. According to Noble (1991:121), three circumstances have mainly contributed to the remarkable outpouring of innovation at BBN: its longtime links to MIT research laboratories, its long association with the Department of Defense, and the inspirational leadership of J.C.R. Licklider[51] (who was an internationally known psycho-acoustician). Wallace Feurzeig came to BBN in 1962 to join the recently formed Artificial Intelligence (AI) Laboratory, headed by Tom Marill. The BBN AI Lab was one of the earliest AI sites, well before the MIT AI Laboratory and other AI research places like Xerox PARC were formed, and research activity within that included pioneering work in computer pattern recognition, natural language understanding, and LISP language development. Much of this work was done in collaboration with MIT researchers; MIT's Marvin Minsky and John McCarthy (co-founders of the MIT AI Lab) were regular BBN consultants during the early 1960s.

At the same time, other groups at BBN were doing research in cognitive science, instructional research, and man-computer communication. Wallace Feurzeig was a mathematician interested in man-machine interaction and programming language design and joined BBN attracted by the possibility of designing interactive computer systems and environments which would expand the capabilities of existing Computer Assisted Instruction (CAI) systems:

I found the dominant kind of CAI quite insulting, the notion that a kid was a vessel into which one poured knowledge was anathema to me. I became interested not in a model where a solid computer asked questions of a student and the student responded, but in a two-way exchange, a "mixed initiative" kind of computing. I wanted to build a system in which the student had equal rights as the system. My passionate interest was in making things interesting from the learning standpoint with computers. (7)

This led to the development of the first "intelligent" CAI system, MENTOR, which supported history-sensitive and context-sensitive kinds of problem solving interactions giving more control to the learner. In 1965 Feurzeig organised the BBN Educational Technology Department to further the development of computer methods for improving learning and teaching. The focus of research there had now shifted to the investigation of programming languages as educational environments. According to Feurzeig (1984:158) this shift was partly due to two recent technological advances --the invention of computer time-sharing and the development of the first high level "conversational" language.

The first successful demonstration of computer time-sharing was done at BBN in 1964. It is significant that research on time-sharing was at the same time going on at MIT on a competitive basis:

The idea of sharing a computer's cycles among several autonomous users, working on-line simultaneously, had stirred the imagination of programmers in Cambridge in 1963 and 1964. BBN and MIT teams raced to be first in realizing this concept, with BBN winning by days (Feurzeig, 1984:158).

As we will see later in this chapter, this element of competition between the two research sites (each one with its distinct "culture of production") had significant implications for the production and evolution of Logo[52].

2.2. Logo work at BBN followed on work with another language, TELCOMP, which was a language with a syntax similar to BASIC. TELCOMP (which was initially called STRINGCOMP) was a dialect of JOSS (the first "conversational" language developed in 1962-63 by Cliff Shaw of the RAND Corporation) and it was introduced to children as a tool for teaching mathematics. In 1964-65 and under the U.S. Office of Education support[53], TELCOMP was experimentally used in eight elementary and secondary schools in mathematics (as an aid to solving standard arithmetic, algebra and trigonometry problems) to see whether the idea of using an interactive language would have any benefits in terms of children's motivation and learning. Daniel Bobrow, Richard Grant and Cynthia Solomon worked closely with Wallace Feurzeig. Seymour Papert was also involved in the project as a consultant from MIT. Finding this activity highly motivating for children, the group extended this research under an existing grant from the Office of Naval Research [ONR, Contract NONR-4340 (00)].

2.3. A programming language designed for children: general features. The idea for a programming language expressly designed for children arose directly from this project. Existing programming languages were thought to be inappropriate for use in education as they were designed for doing computational applications in mathematics, science and engineering rather than for mathematics education. Most languages were thought to be either too limited in expressive range, too specialised in scope or too complicated syntactically to make a valuable contribution to the teaching of mathematical thinking:

> ...they generally lacked facilities for non-numeric symbolic manipulation... they often employed extensive type declarations that got in the way of students' expressive impetus; they had serious deficiencies in control structures; their programs lacked procedural constructs; most had no facilities for dynamic definition and execution; few had well-developed and articulate debugging, diagnostic and editing facilities, so essential for educational applications (Feurzeig, 1984:160).

Wallace Feurzeig at BBN, February 1995.

BASIC, which was the most popular programming language used in maths education at the time, was viewed as being seriously epistemologically wrong. Through his critique of BASIC Feurzeig declares the constructivist orientation which guided the development of Logo:

> The notions that people had about the use of BASIC were much more along the lines of teaching straightforward algorithms and so on. But this didn't really get kids to -in a more fundamental way- think about thinking in all kinds of contexts, to become strategic thinkers, to become more involved in designing and building of knowledge and all that (7).

So Logo was designed for the teaching of both heuristics and formal methods, especially as they apply to mathematics. It was seen as providing an operational universe within which students could define a mathematical process and then see its effects unfold. It was intended to be accessible to very young children for simple tasks, while its operations could be systematically extended to express problems of considerable complexity. The requirements for the new language were:

- it should be accessible to young children and others who have not acquired the elements of mathematical thinking; the only prerequisites for using it should be an acquaintance with the counting numbers and the ability to read at about second-grade level;

- it should be transparently direct, natural-seeming, and easy to use for expressing procedures for simple tasks like many non-numerical problems already familiar to children.

To meet these two requirements, the language should be without difficult technical features like those found in traditional programming languages (e.g. loops, counters, array declarations, etc.)

- it should be organised to facilitate the extension and generalisation of simple mathematical algorithms to more advanced and powerful ones;

- the structure of the language should embody mathematically important concepts and foster the development of a constructive point of view about mathematical work (Feurzeig *et. al.*, 1969:13-14).

Feurzeig (1984:160), summarises the basic requirements for the language as follows: that third-graders should be able to use it for similar tasks with very little preparation; its structure should embody mathematically important concepts with minimal interference from programming conventions; it should permit the expression of mathematically rich numerical as well as non-numerical problems and algorithms. Examples of non-numerical problems or projects that could be done with that first version of Logo included translating English into Pig Latin, making and breaking "secret codes" (e.g. substitution ciphers), a variety of word games (such as testing whether a word is symmetric, finding words within words, writing words backwards, etc); these were sort of problems that children already knew and liked. The strategy of Logo developers was to introduce mathematical ideas through experience with these familiar and meaningful problems and projects[54].

2.4. The first version: actors and features. The first version of Logo was designed by Seymour Papert, Daniel Bobrow and Wallace Feurzeig in 1966. Papert developed the overall functional specifications and the syntax of the new language. Papert was a South-African mathematician who had come to MIT from Geneva where he had worked with Jean Piaget for five years on developmental psychology and learning. He became a consultant to the BBN Logo project in 1964 and at the time he did not have a faculty position at MIT. In the summer of 1965 Papert wrote the basic syntax for Logo which was first implemented by Daniel Bobrow on a Scientific Data Systems SDS 940 computer. Bobrow, also a consultant with System Development Corporation (SDC), had been one of the first graduate students in the MIT Artificial Intelligence group, had been involved with project MAC at MIT and was the manager of BBN's Artificial Intelligence department since 1967. After Bobrow's first implementation, Richard Grant assisted by Cynthia Solomon, Frank Frazier and Paul Wexelblat made substantial modifications to the design and implementation. Bobrow and Solomon (the latter had worked with Papert at MIT previously) had initially suggested that Papert was brought in as a consultant to assist the design of an education-oriented conversational programming language. Paul Wexelblat was the young engineer who in 1971 would make the first RF (wireless) floor "turtle".

Logo was a new procedural language derived from the predominant AI programming language LISP. LISP was widely used in research into Artificial Intelligence and its name is an acronym for *List Processing*. Technically, the first version of Logo was very different from versions of Logo today. It had only one variable, it did not have the flexible number of variables and variable naming that it did very soon thereafter. Also, it did not have any graphics; there would be another four years before graphics. So some of the features usually associated with Logo had not been developed yet. Logo started largely as a list-processing or language-manipulation programming language which was originally anticipated by Feurzeig (1967:87) to be used by students not only in mathematics but also to help them understand the grammatical structure of language. As the following quotation from Feurzeig indicates, there were several ideas about alternative areas of application for the new language:

> Initially the interest was not only mathematics. I named it "Logo" from the Greek "λόγος" which means a word, a thought, the idea, but word is very prominent. And the notion was that computers were not just for doing science or math technical kinds of things; they could be used for language, for music, for all kinds of things, that computers would be interesting to people in various ways. We were interested not only in mathematics but other areas, too. (7)

George Lukas, a young researcher then in the BBN Logo group (today he is Associate Professor of Computer Science at the University of Massachusetts Boston), illustrates this ambiguity which -as I will discuss later- was also the case in the first few years of Logo research at MIT after the MIT Logo Lab was established in 1969:

> One significant thing that we did was also simply trying to find out what Logo could be useful for. Nobody had much idea...You had this very nice and powerful language and nobody really knew exactly what it was suited for. Some were trying to teach students grammar, for instance, by having them use Logo to construct sentences, etc. John Seeley Brown used it with graduate students in sociology at Irvine to implement simple sociological models. Jeanne Bamberger at MIT did work with Logo and music. I used it for remedial maths education (15).

Feurzeig's initial interest about Logo as a learning tool to assist children acquire a constructivist approach to learning about the structure and use of language was realised several years later through his cooperation with Paul Goldenberg

(Goldenberg & Feurzeig, 1987). However, it was the teaching of mathematics that quickly became the dominant area of application for Logo, as a result of the Logo developers' background and interest in mathematics which was coupled with the funding possibilities available to mathematics education projects through the National Science Foundation (NSF) at the time. Thus, a few years after its initial development and before the decade was out, Logo was largely being put at the service of the dominant trends of the times -mathematics education- at the expense of alternative projects which were overshadowed. The 1969 BBN report to the NSF of the experimental research project at Muzzey Junior High and Emerson Element. schools (Feurzeig *et al.*,1969) explicitly established Logo as an alternative conceptual framework for the teaching of mathematics and especially of algebra:

> the purpose of this research has been to investigate the teaching of mathematics in terms of a "sufficiently precise meta-language", [that is] the programming language LOGO, and to explore means of using it as the foundation and framework for a mathematics curriculum (Feurzeig *et al.*, 1969:7).

Regardless though of specific areas of application, it seems that the initial development of Logo was linked to a technological determinist view of educational change which hoped that Logo would become a vehicle for the transformation of education; this view was linked with a constructivist view of learning (and transfer of cognitive skills) derived from cognitive psychology. Feurzeig recalls:

> We had the hope that this would be transformational... we were interested not only in mathematics... And the thought and the hope was that this was going to really revolutionise education. It was a very-very different view about what computers and programming and kids were all about from what people were doing with other technologies like CAI or with BASIC... the hope was that Logo would really get kids to think in a more fundamental way about thinking in all kinds of contexts, to become strategic thinkers, to become more involved in designing and building of knowledge (7).

3. Early school-based projects: players and funding. Experimental research with the new language was initially supported out of an existing project sponsored by the Psychology Division of the Office of Naval Research (ONR) which was investigating new kinds of computer technologies for training in the Navy. The Head of the Division, Dr. Glen Brian, was persuaded to provide funding for experiments with a preliminary version of Logo on condition that the research would be done at a school with military dependent students. This first Logo version was pilot tested with 5th and 6th grade students at the Hanscom[55] Field School in Lincoln, Massachusetts in the summer of 1967. That was the first school-based experiment with Logo and Seymour Papert and Cynthia Solomon taught there for the purposes of the project.

Support by the ONR was only for a few months, just to get the Logo project started. The year after the modest work at Hanscom (1967-68) a new and extended version of Logo was designed which was implemented on a DEC (Digital Equipment Corporation) PDP-1 computer system by Charles R. Morgan. Michael Levin, one of the original implementers of LISP, contributed to the design. From September 1968 through November 1969 the National Science Foundation (NSF) supported the first intensive program of experimental teaching of Logo-based mathematics in elementary and secondary classrooms which took place at Muzzey Junior High School in Lexington, Massachusetts and at Emerson Elementary School in Newton, Massachusetts. Wallace Feurzeig coordinated the research design and implementation. The philosophical and pedagogical point of view adapted for the project was largely due to Seymour Papert. The work of installing and maintaining the computer terminals in the schools was done by Paul

Wexelblat. Wexelblat and Grant were co-teachers of the computer club, an auxiliary activity at the junior high school. The work of programming and maintaining the Logo system for use in this project was initiated by Charles R. Morgan, by 1969 Chairman of the Department of Mathematics, Gordon College, Wenham, Mass., and was continued by R. Grant.

Work at the Emerson Elementary School started with a single computer terminal in January 1969 involving mathematically "average" and "under-achieving" children between 7 and 9. The children were taught by Marjorie Bloom (a professional teacher who had joined the project in July 1968) largely through a series of programmed lessons of a relatively open-ended sort. The main conclusions of the elementary project were:

- children of second and third grade level learn the *elements* of Logo programming with ease;
- most children at this level cannot, during such a short interval, learn to write or debug programs as complex as REVERSE[56];
- children of this age do acquire a meaningful understanding of concepts like variable, function, and formal procedure through their experience with Logo;
- the children showed educational benefits of an extra-mathematical kind as side effects of the teaching. The most evident one was a striking improvement in reading rate for most children during this period (Feurzeig et.al.,1969:32-33).

Work at Muzzey Junior High School started in September 1968 with six terminals and a class of twelve seventh-grade students in the median range of mathematical performance. Marjorie Bloom taught the first part of the course from September to December 1968 introducing children to Logo. Cynthia Solomon and Seymour Papert taught the class from January through June 1969 continuing with a Logo treatment of arithmetic and algebra. At that time, Papert had been recently appointed as professor of Applied Mathematics at MIT, and was a consultant to BBN on this project. During the latter period of the project, Marjorie Bloom taught the group of second and third grade children. Funding for this project came from the Office of Computing Activities (OCA) of the NSF and not from its Education Office within which computers were not legitimate at the time. Even more, the fact that BBN was not a university but a R&D company made it very hard to get the funding from the OCA. Wallace Feurzeig remembers:

> The tradition was funding universities. BBN was a suspect as being a money-grabbing kind of place rather than pure as a drift of snow like universities! So he [the Head of OCA Dr. Milton Rose] said: "Why should I fund you? You are not a university" (7).

On these grounds, obtaining funding for Logo research became even harder for BBN in the next few years as BBN was an R&D organisation dedicated to advanced technical innovation and not a university involved with school-based projects. Especially after the introduction of Logo into schools in the early 1980s (a process which made Logo a school-thing as I will illustrate in Chapter Nine) BBN was not funded by the NSF for Logo projects in contrast with the MIT Logo Lab. As a result, Logo research at BBN continued with limited resources. In 1970 Bob Morgan implemented Logo on the DEC PDP-1 microcomputer. Two years later there was a PDP-10 implementation at BBN. The MIT Logo Lab had their own PDP-10 implementation and they soon created a very successful PDP-11 implementation. As the Logo-race between BBN and MIT went on, things were getting more and more difficult for the former as they suffered funding cuts. Again, the fact that BBN was a R&D company for advanced technical innovation and not a university dedicated to educational research made it almost impossible that its Educational Technology Department would get any NSF funding or personnel for research at schools:

> Because basically if the NSF had the choice of giving money to a college or to BBN, the college would be much preferred (15).

Inevitably the BBN research group remained very small and only few new people joined the project until the mid-1970s. Paul Wexelblat was working on the "turtle" and Wally Weiner was the implementor after Bob Morgan. Thus, as George Lukas remembers, the activity at BBN remained limited and unable to keep up with the pace of the MIT Lab:

> We didn't know where to put our technical effort because we were so limited. We never got funding, we were never successful as MIT, we never had more than four-five people working on the project, so capabilities were limited... so part of the reason why we fell behind [MIT] was because it took so long for us to get the software out (15).

Coming to the 1980s, it became almost impossible for BBN to obtain funding for Logo research. Logo became commercial in the early 1980s and that meant that it was no longer a research issue only. BBN had no access to the Office of Education or to the NSF or to the companies that commercialised Logo, and it was also not involved in teacher training or in research at schools. Therefore, BBN was never funded for dissemination of Logo work at schools, something which was considered to be exclusively the job of universities and also (later) of places like the Education Development Center (EDC, based in Newton, Massachusetts)[57]. While Logo was increasingly becoming a school matter, the BBN Educational Technology department was obliged -for reasons of survival- to look for different areas of activity (like projects in flight instruction and in student training in programming) in order to obtain funding, and therefore Logo research inevitably remained a minor activity.

4. The struggle over the meaning of Logo: reform vs. revolution at BBN and at MIT. From its inception, learning to program in Logo was viewed by its developers as a means to an end rather than as an end in itself:

> Our interest is not to teach programming as an auxiliary topic, but to explore means of using it as a foundation for an integrated course in mathematics (Feurzeig *et. al.*, 1969:11).

While a lot of hope was initially built around Logo which was seen as a tool for constructivist learning, by 1969 had already become obvious that there were fundamental differences in the ways in which different people within the BBN development group tended to view Logo in terms of what the language should be applied to, and in terms of its position in the curriculum and existing school structures. The same fundamental division between what I will call here the "reformist" and "revolutionary" perspectives on Logo arose also within the MIT Logo group soon after its establishment in 1969. I will briefly discuss here these different perspectives and the ways in which they worked out first at BBN and then at MIT.

4.1. The reformers' view. A first group of people within the BBN development team viewed Logo as a curriculum component that would provide a laboratory setting in which students could do many things that they could not do otherwise. They expected that Logo, because it was seen as very flexible, could be used throughout the curriculum from elementary school through college and graduate school to augment courses, to provide new kinds of experiences, to enable students to engage in many different areas as opposed to simply studying about them. From this perspective, Logo was seen as an appropriate interactive tool to help children do formal (mainly mathematical) thinking of certain kinds very early, but this *within the existing school reality* as George Lukas recalls:

> We were interested in augmenting the curriculum at lots of different levels...as opposed to the idea that Logo was a revolutionary new idea which would be the centre of the curriculum (15).

According to this view, innovative Logo activities should be supported by the development of updated curricula and suitable curriculum materials as well as teacher training. At this point, the tension within the group was evident:

> We began to have some so-called "teaching clinics" and so on around 1967 or 1968. I think that there was also a kind of funny attitude on the part of some people that one should not be providing a great deal of curriculum material to support the work because the teachers would tend to use that slavishly instead of getting in the spirit of building what was needed at the time more circumstantially and so on. It was almost religiously thought by some to be just the wrong thing to do (7).

In a similar manner, the reformers within the MIT Logo group (most of them teachers) tended to view Logo as something with great potential but not totally incompatible with school, as something which should be introduced into schools and assist grassroots educational change *from within*. Overall, reformers within both BBN and MIT were more interested in the kind of projects that would be more acceptable by existing standards, tending thus to see the "potential of Logo for change" penetrating traditional schooling through a process of *evolution rather than revolution*. They maintained that a necessary condition for the success of this vision would be the creation of an appropriate "Logo culture" among teachers and the development of appropriate teaching materials. Upon the introduction of Logo into mainstream schools in the early 1980s, the development of such a culture would become the ultimate mission for a small number of members of the MIT Logo group who invested a lot of time and effort in teacher-training through Logo summer schools, workshops and other ways.

4.2. The "revolutionary" perspective on Logo (represented by a number of members of both BBN and the MIT Logo group when the latter was established) tended to adopt a fundamentally different view of Logo as something which was incompatible to the existing form of schooling. The "revolutionaries" (including Papert) tended to view Logo as an anti-school development, as something which was different and, in fact, against school in its traditional form. Logo for them was an expression of moving against the traditional classroom and the academic approach to learning about maths and science in favour of a more experiential way of learning. Papert says:

> At a certain point I did not think of school as savable, I didn't think that school was a proper learning environment... Originally in my head it [Logo] was an anti-school thing... Logo was the cleanest example of an anti-school use of the computer, of a use of the computer very different from anything that happened in the school (18).

From this "de-schooling" position the "revolutionaries" tended to see the computer as a highly personalised conversational partner and Logo as a microworld for the conduct of thought experiments; in Seymour Papert's words, "an object to think with". Instead of focusing on the ways in which computers and Logo could make traditional teaching more efficient or attractive, revolutionaries emphasised that Logo was a computer environment where children should be encouraged to do things in new ways. Rejecting traditional approaches as conservative, the "de-schoolers" pressed strongly in the direction of more heuristic, intuitive, qualitative and experiential approaches for making connections with mathematical and scientific ideas. They advocated a new style of pedagogy: one should allow for free and unstructured exploration with this new tool instead of providing curriculum material which teachers would tend to use slavishly; children were to learn through self-guided discovery methods, pursuing their own goals and ideas with minimal adult intervention or systematic presentation of concepts or skills. Children were to develop general problem-solving skills through self-initiated and self-guided exploration of Logo which was described as a special and rich environment for the acquisition of high-level logical and reasoning skills. Their version of the "Logo philosophy" was being offered as an alternative to the ideas and practices of the existing educational system which was thought to be deeply conservative and alienating; it was offered as a vehicle for "radical" change in educational thought. In this sense, their claims for Logo were also much more overtly political. Rather than viewing Logo as a new tool within the existing curriculum, they saw it as a revolutionary anti-school idea which could potentially bring about radical change in existing perceptions of schooling, teaching and learning and more generally in society and culture[58]. Logo for them was an alternative project away from existing school systems. In fact, for this group, Logo became the expression of oppositional politics beyond the discussion of school, a fight against the status quo. It is interesting to see how oppositional members of that group held themselves to be as an illustration of their self-image, of what they were trying to develop with Logo, and of the naiveté with which they viewed Logo as another way in which they could strike back at the whole of the system. The following anecdote provides windows into the MIT's "culture of production" by helping us understand some of the social and political values and priorities of members of the MIT Logo group, values which were reflected on their work on Logo:

Within the MIT Media Lab, this 'revolutionary' sub-culture in the middle of the Vietnam war was viewed with suspicion by the establishment and its activity was kept an eye on by the CIA which -at that time- interested on all the defense research that was underway at MIT's Technology Square. A member of the group described to me the intellectual arrogance of their "radical political reformist" group against the politicians -and especially the military:

It is interesting that the CIA had an office right on the same floor of the building that we occupied over in Technology Square, that's true. I suspect that the CIA had an office in that building because they wanted to follow what was going on. That was on the third floor, we were on the third floor and on the eighth or ninth floor was the AI group. So they were keeping track of all work. Meanwhile all the radicals and the Logo group and kind of long-period hippie types and anti-government types throughout the building were arrogantly saying "oh, well, they are not these military smart enough to know what we are really doing". There was a tremendous amount of arrogance in that way and people thought they were so smart that the military could not possibly have anybody smart enough to know what they were doing even (28).

From this perspective, the MIT Logo Lab was not simply a place for research into a computer programming language but it was at times turned into an arena of confrontation with the *status quo* as the same member of the group remembers:

There was a time that we had some kind of guerrilla theatre. I don't remember how we did it but [name] and another young friend of mine who was hanging out of the Lab and I, one weekend we took sheets of paper and we wrote CIA at the windows [laughs] and it was like this [the size of the letters was about the height of a room], you could see it from Boston, you could see it coming over the bridge from Boston! And so this woman, a big six-foot-something woman came over and said: "I am from the agency next door.." and I said: "you mean C-I-A...?" She said "I'd like to know what's that on the window!" and I said "what on the window?", you know, on and on. And she said, "well, I think that's not a very good idea". I said "are you threatening me?" And Seymour was not around then, but then people came back and people gathered, it was really an outrageous thing to do. But there was that kind of spirit that we had done that and finally the MIT president called up and ordered that it be taken down (28).

Also, Turkle's (1984) analysis of the MIT computer "hacker" culture and Schön & Turkle's (1994) discussion of MIT history and culture through their analysis of MIT's "Project Athena" micropolitics are particularly useful readings for a deeper understanding of the MIT Logo Lab's culture of production.

5. The move to MIT. The division of perspectives between reformers and revolutionaries within BBN was partly the reason why a number of BBN group members (revolutionaries in orientation) left BBN and followed S. Papert forming the MIT Logo group in 1969. A reformist from the early BBN group remembers:

> Because Papert really had a very different idea of Logo. [Our idea] about Logo was that Logo would be a curriculum component that would provide a laboratory setting in which students could do many things that they couldn't do otherwise. While his [Papert's] idea about Logo was that by explaining something to the computer the student really understands it. And of course the method of explanation to the computer was via a Logo program. And so he felt that Logo would replace everything and also his emphasis was curricula based on Logo. We were pretty much against that (28).

The fundamental conceptual gap between the two approaches, knitted together with disagreements about the technical specifications and design, and accompanied by conflicting aspirations, led to the schism of the initial BBN research group. In 1969 Papert (who had in the meantime taken the Cecil & Ida Green mathematics chair at MIT and was co-director with Marvin Minsky of the AI Department) founded the MIT Logo Lab as a separate research site within of the MIT AI Laboratory. Within the powerful institutional context of MIT, the Logo Lab started developing its own Logo project to follow on the work started at BBN. The project was deeply influenced by the MIT AI Lab culture and thereafter dwarfed BBN's developments. At that point, the fact that BBN was not credited with funding for Logo research any more meant that the development of Logo was set to a particular track. From a social-constructivist point of view, a question arising at this point is whether Logo-the-product would have been any different had BBN been given the ability to continue and expand research. We do not know. What we know is that BBN's limited access to NSF funding for Logo meant that, for good or ill, a particular Logo ideology was being closed off, partly as a result of the ideological struggle between the two relevant social groups. What we also know is that -as research evidence suggests- the division between reformers and revolutionaries continued within the MIT Logo group itself creating internal tensions.

6. The development of Logo at the MIT Lab. At the MIT Logo Lab, a large number of people with diverse backgrounds and interests (aided by an army of research students) were gathered around Papert who obtained large amounts of funding -mainly from National Science Foundation (NSF) grants (as well as corporate sponsors later). Developments at MIT overshadowed Logo research at BBN which was continued with limited resources. Especially after the publication of *Mindstorms* in 1980 which made Logo known to a wider audience, the MIT Logo group -and particularly Seymour Papert- have taken all the credit as the inventors of Logo; as George Lukas recalls:

> He [Papert] was a very charismatic person and very well connected, he had of course obtained very large amounts of funding for MIT and the Logo Lab was in fact quite large... Having LEGO and other sponsors he obtained a very large amount of funding, he gathered around a number of very strong graduate students in the AI Lab and had his own project which dwarfed the BBN project from about 1970 on (15).

The fact that the MIT Logo Lab was established as part of the MIT AI Laboratory meant -among other things- that the Logo project at MIT was from the beginning embedded within a particular "culture of production" which was going to have a fundamental influence on its development: the culture of Artificial Intelligence and the "MIT hackers'" culture. In the context of the AI Lab there was a lot of excitement about AI as a field which was rather new at the time and there was a lot of excitement about the use of the computer as a tool for thinking and for learning about thinking. There was a strong interest in human thought processes and cognition; it was a defining principle of the AI community the attempt to understand what learning was (in cognitive terms) and to help humans acquire better problem-solving abilities, and computers were seen as tools to assist this process by simulating as closely as possible human thought processes. Marvin Minsky's theory of computation (or information processing) and his general theory of intelligence had excited the AI community within which people now felt they could talk about things that nobody had ever really talked about before, and were used as a source of models for explaining psychological phenomena[59].

At the same time, the ideas of Papert about the use of the computer as a tool for thinking and his Piagetian approach to education were very influential within the AI Lab. Influenced by his work with Piaget, Papert maintained that education should be a process of discovery and that children should be given much autonomy and independence to learn rather than being spoon-fed a predesigned curriculum; that they should learn how to learn, and that the computer could assist in that process:

> I left Geneva enormously inspired by Piaget's image of the child, particularly by the idea that children learn so much without being taught. But I was also enormously frustrated by how little he could tell us about how to create conditions for more knowledge to be acquired by children through this marvellous process of "Piagetian learning". I saw the popular idea of designing a "Piagetian Curriculum" as standing Piaget on his head: Piaget is *par excellence* the theorist of learning without curriculum (Papert, 1980:215).

Coming to MIT Papert sought to understand how children think drawing on the theory of computation as a source of models to be used in explaining psychological phenomena. Studying Minsky's models of intelligence, Papert (1980:209) saw ideas from computer science not only as instruments of explanation of how learning and thinking work, but also as instruments of change that might alter, and possibly improve, the way people learn and think. Within the cognitivist pursuits of the AI Lab, the application of "powerful ideas" from AI to education was thought of as providing new tools for solving problems in the educational process. Henry Lieberman, a computer scientist initially involved in 1971, recalls:

> ...we were fired up by Seymour's vision that we could use ideas from AI about how thinking takes place in order to help people learn how to think better and do problem-solving better with powerful ideas like debugging (14).

6.1. People and approaches within the MIT Logo Lab. During the first few years Logo work at MIT remained on a short-term and project-oriented basis. Harold Abelson, Bruce Edwards, Andy diSessa, Ira Goldstein, Ron Lebel, Gary Drescher, Danny Hillis, Robert Lawler, Henry Lieberman, Margaret Minsky, Mark Miller, Mark Gross and Cynthia Solomon were among the many who worked there at that time. Most of these people were computer scientists and engineers -closely associated with the AI Lab- who had an interest in "education", rather than people who were educators and had an interest in computer science. Andy diSessa was a physicist, Harold (Hal) Abelson was a mathematician, Ron Lebel was the chief systems programmer in charge of Logo development. A number of non-computer scientists also joined the Lab a little later, like the psychologist Edith Ackerman, John Berlow (who later worked closely with Papert on *Mindstorms* as an editor), and people from the world of education like Paul Goldenberg and Daniel Watt, each one bringing a different approach to Logo.

The diversity of people's backgrounds and interests within the early MIT Logo group was reflected in the diversity of their approaches and the projects in which they were involved. A large number of people were trying out ideas and were inventing applications, in many cases without specific objectives in mind. Paul Goldenberg, a former mathematics teacher and curriculum developer who joined the MIT Logo Group in 1971, describes this air of experimentation:

> There were some people -Jeanne Bamberger is a good example[60]- who had a very specific objective in mind. But most of us were playing, trying to figure out what this new tool could do, and what kids could do, and what might be fun, and building all kinds of weird things (8).

Henry Lieberman was involved when he was still an MIT undergraduate. Influenced by Papert's vision for the use of AI ideas for teaching and learning, Lieberman became very interested in graphics and in understanding how to make a better programming environment for children using AI ideas. Very much on the Computer Science side Lieberman was hoping

> ...to make better education environments that kids could use to learn using the computer as a medium for experimenting, using it as a tool for thinking (14).

Lieberman made the first raster-graphics system for Logo and the first colour Logo system on the PDP-11 computer. Ira Goldstein and Mark Miller, graduate students at the AI Lab interested in cognition, were doing research on problem-solving processes using Logo as a kind of environment for testing program understanding and debugging. They developed a theoretical framework for the instructional process. Jeanne Bamberger engaged in an investigation of a procedural description of music developing methods for using Logo in musical learning with pre-school and non-readers. She developed a set of tools for manipulating music. Paul Goldenberg was also involved in this project doing part of the programming. Goldenberg himself pioneered using Logo for teaching children with special needs, a project which significantly changed the direction of research on Logo and was later continued and expanded by Sylvia Weir. Goldenberg was a mathematics teacher, curriculum developer and mathematics coordinator, and he was the Mathematics Coordinator for the University of Chicago laboratory schools before he joined the MIT Logo Lab in 1971. He was invited to the Lab as a person from education who had taught extensively and also had some background in computers. Radia Perlman explored techniques for working with much younger children (as young as four years of age) developing input devices other than the keyboard like the buttonbox and the slot machine[61].

6.2. The struggle over the meaning of Logo. Given the diversity of approaches to Logo within the MIT Lab, tensions were to arise and confrontations of ideologies to be played out. I have already discussed a fundamental tension between "reformers" and "revolutionaries" which played itself out both within the MIT group and in terms of the relationship between BBN and MIT. The polarity over the degree of radicalism and departure from traditional schooling structures is illustrated by John Berlow:

> Within the Logo group the people who were kind of MIT hackers -and Seymour, too- they were the kind of people who were more purists in a sense of being more radical about it [Logo] and really wanted nothing to do with school systems, they just wanted to do alternative kinds of projects. But then there were people in the group like Dan Watt, who was a teacher, and Sylvia Weir... who were more interested in the kind of project design that was more acceptable by conventional standards... and Seymour was really very-very opposed to that kind of approach... So there was a kind of deep conflict that way (3).

6.3. Technical development vs dissemination. A further tension over the direction of the Logo project arose between those who prioritised technical development and those in favour of dissemination in schools. It was the tension between how much effort to put into building more technically advanced computer environments as against the effort to spread the existing product and the ideas around it into schools. Lieberman remembers:

> One of the major currents of tensions was over how much effort to put into developing the computer systems versus just trying to get it out into schools and not worrying too much about updating it... My personal preference was always more on the research side, I always thought that we should put more effort into developing new things (14).

This view converges with a common view held by the hacker culture at MIT reflecting a faith that, from the right technology, good things might come. It is a technological determinist element embedded in the MIT hackers' culture which, according to Schön & Turkle (1994:95), defines an "MIT way" of proceeding with research on technology and education: build the ultimate in technically sophisticated information systems, and they will yield the most powerful educational results. Arguably, the settlement of this tension moved Logo to one particular direction rather than another. The NSF was significantly involved in the resolution of this conflict putting pressure in order to make sure that existing Logo implementations were spread into schools and tested as soon as possible rather than supporting new technical developments. The NSF pressure was one of the reasons why Logo became eventually available to schools in the early 1980s (as soon as schools acquired microcomputers), and -for many- rather prematurely.

6.4. Linking production with "consumption": NSF funding as an element of social shaping. The case of funding cuts by the NSF which I discussed in section 3 is only one example of how important choices over the direction of Logo research and the allocation of resources to sustain it were linked to the nature of the organisations involved in the development of Logo and their different "cultures of production". In fact, the initial development of Logo was deeply embedded in social processes linked to the advancement of quite different ideological agendas for education. Evidence in support of this argument can also be found in the case of the MIT Lab in the 1970s which is an example of how funding agencies (the NSF in this case) have favoured certain directions in the development of Logo rather than others. When the MIT Logo Lab was established, the NSF continued to be a main sponsor of Logo research. However, permeated by a conservative preoccupation with academic results on standardised tests, the NSF put enormous pressure on the Logo group to provide evidence of the educational benefits from Logo in these terms. The MIT Logo Group were - throughout the 1970s- critics of standardised testing as a way of determining people's intelligence and educational achievement. Although they agreed that standardised tests might indicate something about people's perceptions of particular subject areas, they did not think that these tests were a measure of a person's understanding. They vigorously opposed standardised tests and grades, still, however, expecting that children in a Logo computer culture would show an improvement in their standardised tests in reading, language, arts, and computational skills. The Logo Group rejected the traditional testing methods of evaluation suggested by the NSF as unable to indicate anything really worthwhile about what students were learning. As John Berlow recalls:

> Seymour was pretty principled when it came down to testing and things like that, he really refused to go along with that (3).

As a result, the MIT Logo project suffered significant funding cuts by the NSF and downsized in 1977 on the grounds that students who had done Logo did not score higher on standardised tests. In terms of both its origins and consequences, this pressure of the NSF to test whether Logo leads to generalised problem-solving enhancement should be viewed as a struggle over the meaning of Logo which connects to the ways in which the research community re-constructed Logo to answer its own concerns; in fact, what we have to do here with is a struggle to subjugate Logo under the dominant paradigm of maths education at the time:

> But at the time, this was the question that needed answering: ... problem-solving was *the* current panacea to set right all that was wrong with American mathematics education. If Logo was to be tested, it had to be against the yardstick which filtered down from the arena of broader socio-educational concerns, not the criteria of a handful of academics from MIT. In being tested, it became changed, reconstructed in the image of these broader concerns, and it was these concerns that lingered in the minds and activities of future researchers. There is no turning back the clock; it was and is too late to restate the objectives of an innovation which had already been shown to fail in the terms laid down for it. Those terms were set by a complex set of social forces...(Noss & Hoyles, 1996:180-81).

Bearing in mind Logo's circuit of production, this tension can be seen as a particularly good example showing how a particular "reading" of Logo by the NSF and the mathematics education community (as something to be integrated into- and boost the existing curriculum) became dominant in the struggle over the meaning of Logo and, in turn, fed-back into the first moment of production imposing material constraints and pressure for the development of Logo as a product in particular directions. Appendix Nine extends the discussion of the struggle over the meaning of Logo between its original developers and the mathematics education and Logo research communities. The following section continues the discussion of the struggle over the meaning of Logo within and between the original research teams themselves.

6.5. Power relations and personal dynamics. As would be expected with the construction of any major artifact of this kind, there is evidence that personal relationships had in their own right an effect of creating tensions within the MIT Logo group which had an impact on decisions about Logo. Discussing interpersonal tensions is a sensitive issue and very difficult for any researcher to report. Therefore, I wish to make clear to the reader at this point that I am not interested in discussing examples of personal likes and dislikes within the group for the sake of gossip. Rather, I will run the risk of reporting snippets of personal dynamics in an attempt to illuminate their sociological significance for this study; that is as an effort to demonstrate that the way interpersonal tensions at the "moment" of production were settled sometimes influenced tangibly the Logo-product which came to be "consumed" in real classrooms in other moments of the circuit. The implication here is that the artefact which eventually became Logo could have been different, had the interpersonal struggles been different.

So, for example, more than one interviewee reported that members of the group with less technical expertise sometimes felt squeezed out and undervalued; some members of the group who were neither mathematicians nor computer scientists (and were, therefore, less interested in the technical development of Logo viewing it, for example, as a psychoanalytic projective medium of high value) felt at times very uncomfortable within (or even excluded from) the group as in most cases discussions were dominated by a preoccupation with technical aspects, cognitive style and progress in mathematics. Tensions about the group structure mixed with personal dynamics saturated various moments of Logo's development. A member of the group summarises the painful and emotional character of the struggle over the group structure which affected the direction of the project:

I think a lot of people emerged from that very scarred, very hurt, because we could not work it out, there were terrible power struggles. People were forced to drop out, people stayed in but emotionally dropped out, people took power, people lost power... there was anger and hatred under the surface and we needed to resolve this... it was too much pain and problems, more than I had anticipated, and it couldn't be resolved... and that's why people had intelligently suppressed it. And when it started to happen people started to cry in our group meetings and yell at each other, and really let it out, and Seymour asked [name] to find a therapist to come and give us group therapy... It didn't work... He talked to us individually but not as a group...The problems were very deep. There was a lot of competition for Seymour's attention and we could never agree on the structure... One of the big casualties was [name] who really did get pushed out as a result of that process and that was a big loss to the community (28).

6.6. Tensions and compromises over specific technical/design decisions provide another window on the social processes and power relations involved at the level of production.

- One tension that came out fairly early was about *standardisation*, that is whether there should be Logo standards laid down by a committee which would define "what true Logo was". That never happened and Seymour Papert himself admits being on both sides at different times.

- The existence or not of functions as first-class objects in Logo (a capability that already existed in other versions of LISP -SCHEME for example) and the potential benefits from it was another hotly debated issue in the group for a long time. To those people in the group who were giving primacy to the use of Logo for mathematics, this feature was of absolute importance[62] as the overriding aesthetic of Logo for them was that Logo should be a beautiful, powerful, elegant mathematical language. However, the price that one had to pay for functions to be first-class objects is that it would be much less learnable as a system for various technical reasons. It is therefore interesting to register the existence of these two competing aesthetics in the development of Logo, learnability and epistemological integrity, two things which do not always conflict.

- The issue of Logo being a "mathematically clean versus easy to get at" programming language was also fought over. This tension was most demonstrably reflected in the debate about syntactic uniformity. The struggle to maintain a uniform syntax for Logo was a reflection of the debate about whether the programming language should be like a mathematical system (where things are very systematic and consistent) or it should be like a natural language where all sorts of different idioms are possible. For a long time Papert tried to maintain Logo syntax as not having any exceptions, with the same set of rules applying across the board rather than a lot of special cases. This was essentially a tension about how different Logo syntax should be from other standard languages. In this sense, the struggle about syntactic uniformity was essentially a struggle for making Logo different from other programming languages. Papert remembers:

> But most languages had just compromised and didn't try to have anything systematic about the syntax. You would have a lot of special case expressions. We didn't want to have special case expressions and I fought quite consistently against that. And we had a lot of fighting about that, but usually I won on that (18).

The tension over uniform notation -an issue which is still being debated today- had started in the early days at BBN as a disagreement between Papert and Feurzeig. The following quotation by Feurzeig about the conflict over prefix notation illustrates how the shaping of specific technical features of Logo was embedded in broader social processes like the struggles over cultural conventions and in the history of programming languages:

> Seymour said: " I don't see why we have to observe those conventions, they are arbitrary". So I argued and said: "That's fine. But nobody will pay any attention to it because these conventions are so well established it's not a question of what **ought** to be in principle, but the reality is that some things are cast in concrete so strongly that just people would think it's crazy if... (7).

Brian Harvey's two observations that follow below are examples of how closely interrelated the moments of production and "consumption" are in the circuit of Logo: first, that an implication of the key-decision for syntactic uniformity was that Logo became more difficult for younger users

The cost of it [syntactic uniformity] is that doing the most straightforward thing becomes a little funny-looking, you know, if you are dealing with seven year olds it's hard to explain why you have to put that quotation mark in front of the name of the procedure name you want to edit [if one is using, for example, the EDIT command]... it makes it a little harder to explain the notation. So this is still kind of a battle really to this day (10).

Second, that uniform notation allows a clearer view of the evaluation of a procedure and this automatically means that this choice privileges teaching which tries explicitly to focus attention on the evaluation process, something which is usually done with children of an older age:

For my purposes -teaching high school students computer science- I want to focus attention on the evaluation process. So the uniform evaluation process is good for me. If you are doing turtle graphics with little kids maybe you would like not to focus attention on the evaluation process and you would like to have that to be invisible and to think about other issues and maybe you would make a different choice (10).

- Compromises over sensitive design decisions were frequent. An example of such a compromise is given by Papert:

I thought the right way to deal with variables in Logo was always through the metaphor of "it's a name". So I wanted the language of Logo to represent it so that we can say, for example, NAME 3 X... Other people wanted to have something that sounded more like the mathematical notation like "LET X BE 3". And since LET had been used for something else the idea of "MAKE x BE 3" became a standard kind of syntax. I think that was under the influence of wanting to make it look more like mathematics. And I tried to struggle against it. And the compromise there is that most implementations of Logo allow both of those ways of doing it. But most of the books about Logo take the MAKE one, the one that's more influenced by mathematical usage rather than by what I think is a clearer, a more logical way of doing it (18).

• There have been times also that the limitations of the technology available faced people with choices which ended up as compromises over technical decisions about Logo. However, I wish to make clear that the choices -the actual compromises- were not dictated by the technology available. The solutions to technical dilemmas were social; it was people who made the final decisions for social and personal reasons when faced with these dilemmas. The compromise over the data structures *lists* and *arrays* (the whole package of FIRST, BUTFIRST, WORD, SENTENCE, etc.) in the Apple II version of Logo is an example:

> The Apple II was a really small computer and there wasn't room to put in everything, so we had to leave some things out. So we couldn't have both things (lists and arrays) at the same time, we had to pick one. And essentially the choice was between generality and speed. With arrays you can access information a little faster but they are not as flexible because you have to say how big it is ahead of time. And so we chose to go for lists which was a more general thing (10).

• Another design-related tension in the group which lasted for long was deciding about how high-level or low-level Logo commands should be. On the one hand there were those who maintained that it was a useful exercise to write your own commands like REPEAT or COUNT using the necessary simple recursive structure. On the other hand there were those who argued that these commands were so commonly needed for simple projects that kids often needed them before they had the ability to write them and thus were hindered by not having them ready-made. They argued that the availability of the ready-to-use commands allowed -especially younger kids- for projects of greater complexity.

7. The issue of turtle graphics. Of all the smaller or bigger issues struggled over in the development/evolution of Logo to date, the issue of turtle graphics deserves special attention. Logo was initially built without a "turtle"; in the first research report (Feurzeig *et al.*, 1969) emphasis was on algebra. The turtle graphics microworld was introduced into Logo in 1970 when the first robot "turtle" was developed (Solomon, 1979:50).

IMAGE REDACTED DUE TO THIRD PARTY RIGHTS OR OTHER LEGAL ISSUES

Children working at BBN with one of the first wireless turtle-robots (named "Irving") in the early 1970s (photo courtesy of Wallace Feurzeig, BBN).

The data gathered for this research suggest that the introduction of the "turtle" created some sort of tension among Logo's developers -as well as considerable confusion among Logo's users which fedback to designers' perceptions. The data suggests that -even today- there is still a question mark hanging over the original intentions of Logo's designers as far as the "turtle" is concerned. The tension emerged from the fact that the frequent use of the "turtle" as a concrete and relatively easy entry point to the language for beginners resulted in the misunderstanding that Logo is all about turtle graphics. This false belief that Logo=turtle graphics is described clearly by Harvey (1985) who points out that the "turtle" alone is not a way into the whole picture[63]:

> Logo is best known as the language that introduced the *turtle* as a tool for computer graphics. In fact, to many people, Logo and turtle graphics are synonymous. Some computer companies get away with selling products they call "Logo" that provide nothing *but* turtle graphics... Historically, this idea that Logo is mainly turtle graphics is a mistake...Logo's name comes from the Greek word for *word*, because Logo was first designed as a language in which to manipulate language: words and sentences (Harvey, 1985:121).

This tension will be further discussed in chapters Six and Seven (moments 2 and 3 of Logo's circuit respectively). The issue of turtle graphics was not resolved once and for all in "moment 1". Rather, it was an issue that it was re-contextualised and constantly struggled over throughout the whole circuit of Logo's production. Part of Chapter Six will show that the introduction of the "turtle" was a contradiction built into Logo in terms of its epistemological principles and technical design. Perhaps more interestingly, Chapter Seven will discuss how the issue of turtle graphics has been struggled over during Logo's re-contextualisation into British schools. I will argue there that while designers at the level of production largely saw the "turtle" as a kind of physical embodiment of the algebra and geometry existing and introduced it as an easy entry-route to Logo for non-mathematical beginners, in the eyes of many teachers at the level of "consumption" the "turtle" became very quickly a focus of attention itself, creating a tension with the original intentions of Logo's designers. I will illustrate there how this dominant assumption (reading) among Logo's users that Logo was only for turtle graphics became so strongly established among primary teachers (and fed back to the producers) that from being initially conceived by its producers as an entry-route to the deep aesthetics of programming, the turtle eventually became a cul-de-sac as it was interpreted only as a means for drawing pictures. In addition, I will show in Chapter Seven that this dominant "reading" of Logo as turtle graphics at the level of "consumption" was not independent from economic and political decisions reflecting the wider context of use.

8. Conclusion. Using elements of a cultural studies approach to technology, this chapter has provided a discussion of the first "moment" in Logo's circuit of production. Analysis has included considering some of the distinctive characteristics of the BBN and MIT cultures of production as they related to the production of Logo. The general conclusion which can be drawn is that the initial development as well as the evolution of Logo was socially constructed. Logo did not evolve only on its technical merits, but rather it was the product of considerable social, political and economic influences and decisions. The lack of agreement on standards, the conflict of interests between the various groups involved, the range of approaches and "readings" within, between and beyond the research teams, are clues supporting the argument that the evolution of Logo was not linear nor even primarily technical. The various individuals, social groups and/or institutions involved lobbied for the system they wanted, all making claims to support what were inconclusive data about the educational value of Logo. Moreover, as it will become more evident in the discussion of other "moments' of the circuit, the problems, solutions and social groups associated with Logo changed during the course of its evolution -they were "redefined" as they were "recontextualised".

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CHAPTER SIX

Logo as Text

1. Summary of the fundamental principles guiding Logo's technical design.

As already mentioned in Chapter One, Logo-the-language has been the material embodiment of the "Logo philosophy" for education which has been developing alongside the technological artefact; Chapter One has already presented some of the fundamental elements of this philosophy through its presentation of *Mindstorms*. The "dominant" Logo discourse of the late 1970s and early 1980s as exemplified mainly in *Mindstorms* maintained that the intellectual environments offered to children by their surrounding culture and their schooling were poor in opportunities to bring their thinking about thinking into the open, to learn to talk about it and to test their ideas by externalising them, while access to computers could dramatically change this situation. To this end, it was argued that a combination of the massive penetration of technology with the growing disillusion with traditional education would be good for children, for parents, and for learning through the construction of educationally powerful computational environments that would provide alternatives to traditional classrooms and traditional instruction. Logo was presented as an example only of such an environment:

> They [Logo environments] are too primitive, too limited by the technology of the 1970s. The role I hope they fill is that of a model (Papert, 1980:182).

Overall, the Logo discourse suggested a number of educational metaphors as illustrations of its principles. These principles, or -rather- the compromises that emerged from struggles over them as discussed in Chapter Five, were "encoded" in the structural design of Logo-the-language. For its designers wanted Logo to be unique among computer languages in that it brought with it a "philosophy" of education. It was intended to form a foundation for an entirely new kind of school based on Piagetian approaches to teaching and learning, using computers as all-purpose tools to facilitate (mainly mathematical) learning through a constructivist approach. Among the fundamental principles and metaphors embodied in Logo as conceived by Papert are the following:

Some fundamental principles and metaphors embodied in Logo
• Logo is seen as a context within which there is no authoritarianism or explicit control exercised by the teacher;
• within this context, the child has wide powers over what he/she selects, over how he/she structures and over the time-scale of his/her activities;
• Logo is seen as a learning environment whereby the child regulates his/her own movements and social relationships;
• as a learning environment whereby there is no emphasis upon the transmission and acquisition of specific skills;
• as a learning environment whereby the criteria for evaluating the pedagogy are multiple and diffuse and so not easily measured;
• as an environment whereby there is a high level of interaction between participants;
• as a language which would allow for self expression and accommodation of various individual learning-styles;
• the classroom is seen as a laboratory that fosters free exploration and discovery;
• the teachers and students are seen as co-learners without confining curriculum or methods;
• the teacher is seen as anthropologist (in search of that part of the culture that is relevant for education), arranging the context which children are expected to re-arrange and explore;
• the student is seen as epistemologist (who not only thinks, but thinks about the nature of knowledge and thinking as well);
• learning is seen as similar to the acquisition of a first language;
• scientific knowledge is seen as coming to know a friend (rather than as a set of formal propositions and procedures)

Specifically in terms of mathematics learning, Papert (1980:54) discloses at least three "learning principles" which have guided the structural design of Logo:

- the principle of *continuity*: math knowledge must be continuous with well-established personal knowledge. It must have warmth and value as well as "cognitive competence";
- the principle of *power*: learning must empower the learner to perform personally meaningful projects that could not otherwise be done;
- the principle of *cultural resonance* (or *cultural syntonicity*): learning must make sense in terms of a larger social context[64].

2. Logo-as-text. As I have already discussed in Chapter Four, in his discussion of the Mini Metro Johnson highlights the way in which the Metro as a cultural object consists of far more than just a physical artefact, suggesting that it might be more appropriate to consider it as being constituted by an ensemble of interrelated "texts". Along the same lines, I have argued (also in Chapter Four) that the co-existence of the theoretical and the technical in Logo requires that any analysis of it as a "text" should take account of both Logo-the-language and the educational "philosophy" behind it, that the two should be taken together as a textual "package". In this sense, the aim of this chapter is twofold:

- to identify some of the fundamental principles of the "Logo philosophy" for education and situate it theoretically;
- to provide examples of how certain theoretical and epistemological principles of the "Logo philosophy" for education were inscribed in the technical design of the language.

For the purposes of analysis of this "moment", I tend to assume Logo as a "readerly" rather than as a "writerly" text throughout this chapter based on the distinction outlined by Ball (1990b)[65]. However, as I will emphasise in the discussion of moment 5 (*readings/ consumption*) in Chapter Nine, the fact that Logo was "encoded" with certain preferred meanings does not imply that "consumption" was a passive activity involving users following a pre-written script. After the discussion of the "cultural circuit" in Chapter Four, it has become clear that to assume a direct correspondence between the "preferred meanings" encoded in a "text" like Logo and their "reading" at the level of use would ignore the complexity of meaning-making and appropriation at the level of "consumption". Therefore, this discussion of Logo-as-text is an artificially abstracted discussion of a series of <u>possibilities only</u> that the processes of Logo's production provided and which might or might not be realised in the context of use.

Moreover, I understand that thirty years after the initial development of Logo, the Logo discourse remains very complex and diverse, the Logo-text is constantly remade; in fact, it is not possible to speak of a single "Logo-text" or a single "Logo discourse". Therefore, I wish to remind the reader at this point of my conscious decision to concentrate, for the purposes of analysis, on the Logo discourse of the late 1970s and early 1980s as exemplified mainly in Papert's *Mindstorms* which was an advertising text which has played a very important role in fixing the image and meaning of Logo (see Appendix Seven). As already indicated above, by this selective treatment, I do not mean that Logo= Logo as presented in *Mindstorms*. It should not escape us, for example that -as a result of the compromises discussed in the previous chapter- there may already have been some tensions between the message of *Mindstorms* and the message "encoded" in the language. Therefore, the reader should not forget at any point throughout this thesis that -even though the message of *Mindstorms* has been a powerful one- the meaning of Logo is not entirely fixed but, rather, there are actually different meanings that different people can call out.

3. Locating the Logo discourse. The basic elements of the "Logo discourse" as represented in *Mindstorms* have been presented in Chapter One and will not be repeated here at length. As a brief summary, however, we may remember that Papert sees learning as a constructive process. He believes that one of Piaget's most important contributions is not that there are stages of development but that people possess different theories about the world; children's theories contrast sharply with adult theories. For Papert, the process by which these theories are transformed is a *constructivist* one; children build their own intellectual structures. They use readily available materials, which they find in their own cultures. Papert believes that children learn best when they are encouraged to draw on their own intuition and put to use what they already know in developing new ideas. He sees the computer as providing a context in which this kind of learning can happen. For this to happen, the computer's assets have to be molded to the children's needs and a new kind of mathematics that coincides with natural developmental learning processes has to be invented. Logo environments are presented as such an appropriate context for constructivist learning.

Considering that the central underpinnings of progressivism in the post-war period are its child/student centredness, its focus on relevance, its concern to relate to the interests of the child thereby enhancing motivation and willingness to learn, and its concern with integration (see Avis, 1991; Gordon, 1985), it becomes obvious (also from the principles listed in section one) that the Logo discourse of the late 1970s and early 1980s was largely neo-progressive[66] in orientation, echoing the intersections between learning, teaching and knowledge of "situated cognition" and the ideas of Dewey. The important thing for both progressivism and Logo is not so much what is learned, but rather the process of learning. For both, the offshoot is that learning is individualised, children are perceived to develop at different rates and the pedagogic milieu should accommodate this.

Features of a broadly "progressive" tradition were already in place in a few schools in the US and the UK in the 1970s and the "Logo discourse" fitted well in their context. Paul Goldenberg, a former member of the MIT Logo Group and currently curriculum developer at the Education Development Center in Newton, Mass. remembers:

> I came into the project [Logo] with ideas of teaching that I still hold very strongly, that are associated with what might be loosely called "progressive education" in this country. Logo fitted within that stream of thought. To me Logo was not inventing something new in its approach to education... student-centred learning, groups of people learning together. When I came to this environment I already had a belief in these ideas (8).

However, labels like "progressive" or "neo-progressive" sound crude as a way of positioning the Logo discourse within the spectrum of radical educational thinking[67]. In fact, the Logo discourse draws on a whole range of philosophical positions and appropriates a variety of intellectual influences -some of which have not been explicitly acknowledged by Logo's developers. It is thus difficult to classify the Logo discourse and attach to it a particular intellectual label among the many which could partly characterise it like: child-centred progressivist, radical progressivist, liberal progressivist, instrumental progressivist, critical progressivist, deschooling, libertarian progressivist, emancipatory liberal. Papert himself (1979:85) has explicitly situated his own work in the context of progressivism, in the tradition of

Dewey, Neil and Montessori, arguing that their views were fundamentally correct but "failed for lack of a technological basis". Equally explicitly Papert has renewed his contract with progressivism in his work in the 1990s:

There is a family resemblance (and I will accept the word *progressive* to name it) between the vision of learning I am presenting here and certain philosophical principles expressed in the diverse forms of innovations that go under such names as *progressive* or *open* or *child-centred* or *constructivist* or *radical* education. I certainly share with this broad movement the criticism of School as casting the child in the role of passive recipient of knowledge (Papert, 1993:14).

However, the task of locating precisely the Logo discourse of the late 1970s and early 1980s within progressivism becomes even more difficult given the range of alternative meanings covered by the term "progressive" as educationalists never seem to have been very precise about what they mean by "progressive education":

As progressive educators were, in fact, united much more by what they were against than by what they were for, the label appears always to have been considered appropriate to a range of rather different educational theories and practices drawing on philosophies as different as libertarianism, socialism and liberalism (Dale, 1979a:191).

Given that the various strands of progressivism are not exhaustive or mutually exclusive, it is precisely this flow between the different progressivist strands that characterises the Logo discourse, the blurred edges and the co-existence of strands in the debate, in the thinking of educationalists and in the ethos and practices of schools that colours Logo as an educational innovation as a whole.

4. Examples of progressivist assumptions in the Logo discourse. Section One has provided a long list of progressivist assumptions about knowledge, learning and pedagogy which can be found in the Logo discourse. This list can be extended to include the following:

- play is not distinguished from work as the predominant mode of learning in early childhood;
- when two or more children are interested in exploring the same problem with Logo, they will often choose to collaborate in some way;
- children learn and develop intellectually not only at their own rate but in their own style;
- children pass through similar stages of intellectual development, each however, in his/her own way and at his/her own rate and at his/her own time;
- knowledge is a function of one's personal integration of experience and therefore does not fall into neatly separate categories or "disciplines";

Overall, we can distinguish at least two major assumptions in the list of progressivist principles permeating the Logo discourse:

- a celebration of individuality and the belief that such individuality thrives best where it is least fettered;

- the belief that pupils know best what they want to learn and learn best what they want to know.

The data collected for this study contain several statements representing these views. Notice in the following excerpt, for example, the assumption that the child will display natural and creative exploratory behaviour within a Logo microworld environment whereby it is not threatened:

> But if the teacher is prepared to give the children the freedom to actually explore for themselves and guide the children along every now and again, then I think the child sees the activities as very creative process (19).

Or the faith that children will be likely to learn if they are given considerable freedom in the choice of questions/problems they wish to pursue with Logo which is evident in the following quotation:

Control has to be at the centre of it. In my view, if the children are in full control of what they are doing [with Logo) and are deciding their own aims, and deciding their own objectives, deciding themselves which projects to take onboard, then... there is a fighting chance that children will learn. When children want to do things, then I think they learn them (9).

"Debugging" (described in Chapter One) is a fundamental principle linked to the exploratory learning "progressive" philosophy, a principle which is closely linked to the autonomy,. control, and ownership of a project. Errors are necessarily a part of the learning process; they are to be expected and even desired, for they contain information essential for further learning:

That's another fundamental principle, to have the children more in control of what they do because they can try things out and debug as opposed to having the only source of evaluation being the teacher (11).

Confidence in self is highly related to capacity for learning and for making important choices affecting one's learning; children have both the competence and the right to make significant decisions concerning their own learning:

I have always encouraged children to use Logo to develop their own projects, to decide for themselves on something they wanted to draw (2).

5. Linking production and "consumption" through epistemology: elements of a "Logo culture". Logo's developers expected that the translation of the "Logo philosophy" into pedagogical practice would give rise to a distinct "Logo culture", that is a learning environment whereby:

- there is a high level of interaction between the participants (teacher and child and also between children) and this interaction is relatively symmetrical;
- there is a free interchange of ideas and information between participants when they need that information;

- participants are encouraged to work on their "own" projects i.e. ones that they are personally committed to and interested in;
- participants are working on a level that is appropriate to their motivational and intellectual level;
- information should not be spoon fed to students but must be accessible to them when they require it;
- rewards are intrinsic;
- people are encouraged to "play around with half baked ideas" and to take risks;
- where possible there are few preconceived ideas about what students are going to learn in a particular session and the curriculum is flexible;
- everyone, including the teacher, is openly learning and sharing their experiences in the situation.

These expectations of Logo's designers for the development of an "alternative" culture in terms of knowledge, curriculum and pedagogy can be usefully looked at considering Bernstein's work on the classification and framing of educational knowledge (Bernstein, 1977,1996). Based on Bernstein's much-quoted dictum that

> How a society selects, distributes, transmits and evaluates the educational knowledge it considers to be public, reflects both the distribution of power and the principles of social control (Bernstein, 1977:85),

I suggest that we can discuss Logo as a "text" from at least two closely interrelated perspectives:

- in terms of its approach to the organisation of the curriculum and
- in terms of the form of pedagogy that such an approach implies.

Bernstein (1977) distinguishes between two broad types of curricula, *collection* and *integrated*, elaborating this distinction through the establishment of the concepts "classification" and "frame". Logo, from its inception, was offered as an "integrated code"[68], it was a marked attempt to reduce the strength of classification and subject insulation. It was consciously designed in such a way whereby we have a shift from content closure to content openness, from strong to markedly reduced classification:

In LOGO environments we have done some blurring of boundaries: No particular computer activities are set aside as "learning mathematics" (Papert, 1980:48).

Considering, however, that -as Bernstein himself puts it-

attempts to change degrees of insulation reveal the power relations on which the classification is based and which it reproduces (Bernstein,1996:21)

one can understand that this conscious decision at the level of Logo's production to disturb the classification of knowledge was going to the opposite direction of traditional schooling and its formal curriculum:

...most teachers who consult me... [ask] about classroom organization, scheduling problems, pedagogical issues raised... and especially about how it [Logo] relates conceptually to the rest of the curriculum. Of course the Turtle can help in the teaching of traditional curriculum, but I have thought of it as a vehicle for Piagetian learning, which to me is learning without curriculum (Papert, 1980:31).

It was therefore explicitly intended by the developers of Logo that this disturbance in classification of knowledge would lead to a disturbance of existing authority structures, existing specific educational identities and concepts of property:

Appropriation [is the most significant concept underlying Logo]. Appropriating the computer is that's what you are learning about, or using the computer to appropriate other knowledge, in other words, to make this knowledge your own. When people fall in love with a certain type of knowledge, they learn it very easily. If they don't fall in love with it, it can be difficult to learn. Appropriation is something our educational system is weak on. The emphasis of educational practice and research is on what children know, not on how they relate to it [Papert, in Reinhold (1986:35)]

Where does the notion of curriculum fit in? I see learning in this kind of environment as more than anything else like the child's acquisition of language, which is certainly not guided in any sense by curriculum but is a process of acculturation. Such processes work through the personal appropriation of knowledge from the surrounding culture. I see the computer as an agent for exposing the child to a set of possibilities for acculturation, whether in mathematics, in science, or in language itself. This image of learning suggests a critique of what a school is all about and even raises the question if such demarcated institutions as schools make any sense (Papert, 1979:85).

In a Logo environment whereby we have integration, the various contents are subordinate to some idea which reduces their isolation from each other. Thus integration reduces the authority of the separate contents. According to Bernstein, this has implications for existing authority structures, there is a shift in the balance of power, in the pedagogical relationship between teacher and taught. In this sense, Logo offered the possibility of a radical shift in power relations in the classroom as the following quotation from Brian Harvey indicates:

Another Logo-like aspect... was the social interaction in the lab. *There was no formal class-time*; people would come and go to use the machine or just to hang out. An organisation of students took responsibility for running the lab, and its members were given keys to the room so that they could use the machine without supervision evenings and weekends... (10).

The application of such principles implies a particular form of pedagogy which Bernstein (1977:117) calls "invisible". In terms of the concepts of classification and frame, argues Bernstein, this pedagogy is realised through weak classification and weak frames. In order to succeed in its quest for integration, any Logo activity is permeated by some relational idea, a supra-content concept which focuses upon general principles at a high level of abstraction (e.g. the concepts of syntonicity and intellectual depth). The particulars of each subject have reduced significance as Dave Pratt, a lecturer in mathematics education (a former mathematics teacher and curriculum developer) argues:

So in a Logo microworld situation the children are in a context where there are various tools and resources around and the microworld offers a focus for the learning but doesn't sort of offer a narrow path down which the children have to go (19).

This focuses attention upon the deep structure of each subject, rather than upon its surface structure. According to Bernstein (1977:102), such an approach leads to an emphasis upon, and the exploration of, *general* principles and the concepts through which these principles are obtained. In turn, says Bernstein, this is likely to affect the orientation of the pedagogy, which will be less concerned to emphasise the need to acquire *states* of knowledge, but will be more concerned to emphasise *how* knowledge is created. In other words, the pedagogy of Logo as an integrated code emphasised various *ways* of knowing in the pedagogical relationships.

As already said, Bernstein (1977:102) argues that with integrated codes, the pedagogy is likely to proceed from the deep structure to the surface structure. We can see this clearly in Logo. Arguably, Logo -in theory- makes available from the beginning of the pupil's educational career the deep structure of the knowledge, i.e. the principles for the generating of new knowledge, as is indicated in the following words of Feurzeig:

> The notions that people had about the use of BASIC were much more along the lines of teaching straightforward algorithms and so on. But this didn't really get kids to in a more fundamental way think about thinking in all kinds of contexts, to become strategic thinkers, to become more involved in designing and building of knowledge and all that. So we were interested for example in kids having a constructivist approach to learning about the structure and use of language (7).

Such emphasis upon various *ways* of knowing, rather than upon the attainment of *states* of knowledge, is likely to affect not only the emphasis of the pedagogy, but the underlying theory of learning. The underlying theory of learning of collection codes is usually didactic, while the theory of learning of Logo and other integrated codes is more group and self-regulated. It arises out of a different concept of what counts as having knowledge, which in turn leads to a different concept of how the knowledge is to be acquired, in Logo it was a *constructivist* approach to knowledge as Molly and Dan Watt (curriculum developers at EDC and teacher trainers in Logo) indicate:

> [Logo] was a departure in terms of the pedagogical style... we have a term that is now fairly widely used in this country, 'constructivism'. Logo was exactly that, the notion of people constructing knowledge based on their experience of the world and playing with what they already know and working with other people, and the notion that the teacher should be a helper rather than a dictator or instructor in the old-fashioned sense...(23).

These changes in emphasis and orientation of the pedagogy are initially responsible for the relaxed frames, which teacher and taught enter . In this sense, a relaxed frame like Logo not only -in theory- changes the nature of the authority relationships by increasing the rights of the taught, it can also weaken or blur the boundary between what may or may not be taught, and so *more* of the teacher and taught is likely to enter this pedagogical frame. The inherent logic of Logo as an integrated code then, is likely to create a change in the structure of teaching groups, which are likely to exhibit considerable flexibility. The concept of relatively weak boundary maintenance which is the core principle of integrated codes like Logo is realised both in the structuring of educational knowledge *and* in the organisation of the social relationships. It can be argued, therefore, that Logo as an integrated code embodying certain principles was a potentially powerful "emancipatory" discourse in radical education as Wallace Feurzeig indicates:

> Essentially what Logo calls for is project-based kind of work, where kids have projects that they work on. But the project-based thing doesn't necessarily work with the 40 minute class where everybody does this now, etc. So all of that has to do with the social milieu of schools and all these issues that are involved in restructuring and reform and so on (7).

In summary, the Logo discourse -implicitly and explicitly- urged for a move from the "standard" collection to an integrated code. It was hoped that such a move would bring about a disturbance in the structure and distribution of power, in property relationships and in existing educational identities. For Bernstein (1977) such a change of educational code involves a fundamental change in the nature and strength of boundaries. It involves a change in what counts as having knowledge, in what counts as a valid transmission of knowledge, in what counts as a valid realisation of knowledge and a change in the organisational context. At the cultural level, it involves a shift from the keeping of categories pure to the mixing of categories; while at the level of socialisation the outcomes of integrated codes like Logo *could* be less predictable than the outcomes of collection codes. This change of code involves fundamental changes in the classification and framing of knowledge and so changes in the structure and distribution of power and in principles of control:

> It can be seen that the nature of classification and framing affects the authority/ power structure which controls the dissemination of educational knowledge, and the *form* of the knowledge transmitted. In this way, principles of power and social control are realized through educational knowledge codes and, through the codes, enter into and shape consciousness. Thus, variations within and change of knowledge codes should be of critical concern to sociologists (Bernstein, 1977:94).

It is no wonder, therefore, that deep-felt resistances are called out by such an attempted shift in educational codes. Given the complex relationships between educational codes and the structure of power and principles of social control, attempts to change or modify educational codes will be resisted at a number of levels, irrespective of the intrinsic educational merit of a particular code. Chapters Eight and Nine will discuss the difficult road of Logo through such resistances and will show how Logo's "emancipatory" potential interacted with its social context of use.

The remainder of this chapter focuses upon the design of Logo. It shows how elements of two key-"moments" of my cultural circuit of Logo (production and consumption) "articulate" with each other, reminding us once again the artificial and analytic character of the model.

6. Linking production and "consumption" through technical design: Logo-the-language and the embodiment of principles. Logo-the-language was the semiological embodiment of the Logo discourse. These fundamental principles ("powerful ideas") had to be realised in the technical form of the language; its structural design had to reflect this epistemological and pedagogical approach. In search of such a model, therefore, the design of Logo sought to meet several goals; Logo as a programming language had to be:

- easy to learn and use in powerful ways;
- structured in a way similar to the way people think;
- powerful enough to perform interesting and meaningful tasks;
- designed to require the use of structured programming techniques;
- similar in design to other AI languages, (i.e. LISP), with procedural and list processing structures;
- rich in embedded meta-cognitive content, (i.e. problem-solving), and embedded content from scientific subject areas like geometry and mathematics.

Chapter Five has shown that there has been a conscious effort on the part of Logo's developers to inscribe ("encode") neo-progressive, constructivist principles in the structural design of Logo-the-language:

> The original Logo team had these ideals... Those got embedded in the design process when they were actually producing Logo, and when they decided to publish/spread Logo it was inevitable that the philosophical aspects would be entangled with Logo as a programming language (19).

These principles are realised through structures in the language and through support for the language as "a tool for exploration and discovery". Logo is a procedural list-processing language composed of simple commands that may be used to create procedurally structured programs and handle bottom-up, structured and recursive program designs. Concepts from geometry are embedded in turtle graphics, and concepts from programming and problem-solving are used when creating programs.

The principles of *syntonicity* and *intellectual depth* underlie the structural design of Logo. Papert (1980:63,68) describes the "turtle" as being body syntonic, ego syntonic, and culturally syntonic. He claims that syntonicity is achieved through the design of turtle geometry primitives that parallel human movement, and through the procedural structure of the language which parallels the structure of human thinking. Summarising her discussion of Papert's concept of syntonicity, Pomper (1990:87) concludes that syntonicity is structured in Logo-the-language through:

- simple English-like primitives that describe movement of a body in space and the heading of that body
- a "turtle" that corresponds to a point in space and moves like a body in space
- graphics that are achieved quickly through simple commands
- procedures that may be created to correspond to steps in a problem solving process
- capability to extend the language through procedure creation
- naming capability so that procedures and variables may be named with meaningful expressions;
- the variety of capabilities available -graphics, list processing, and interactivity;
- immediacy of results;
- capabilities that encourage exploration through specific primitives that allow repeating, randomisation, variables, error identification, editing capabilities.

According to Pomper (1990:90), the principle of *intellectual depth* is realised in the design of Logo through structures that include:

- procedure creation that encourages development of modular programs that include super-procedures, procedures, and sub-procedures (although, not required, and therefore accommodating to individual styles)

- a meaningful written programming language that requires written articulation of thoughts and ideas;

- procedures built from primitives and other procedures;

- immediate testing of procedures and programs;

- immediate, and in some cases specific, feedback on errors, and error analysis capability, and

- primitive capabilities that encourage exploration and that can be used for creative fun based on individual style.

Hoyles & Sutherland (1992) summarise the main features of Logo as a programming language as follows:

1. *It is procedural and extensible.* A procedure is a group of commands which have been given a name (the procedure name). The procedure commands can consist of Logo primitives or other procedures. Nested layers of procedures can be defined and throughout this book we shall refer to a procedure which is part of another procedure as a subprocedure. We shall also refer to the procedure which contains other procedures as a superprocedure. Procedures can communicate with each other via variable input. It is the procedural nature of Logo which enables the programmer to design structured programs.

2. *It is interactive.* Any Logo primitive or procedure is executed by typing it into the computer so the feedback is immediate and errors can be corrected as they occur.

3. *The data structure of Logo is lists.* A list consists of an ordered sequence of elements which may be numbers, words or other lists. Lists provide a powerful means to create complex data structures.

4. *It is functional.* In a functional language such as Logo the underlying model of an operation is a mathematical function.

5. *It is recursive.* The facility to use recursive procedures enables brief and elegant programs captivating the central structure of a problem to be used in complex structures (Hoyles & Sutherland, 1992:6-7)

7. The "turtle": a contradiction built-into Logo cutting across moments.

The principle of *syntonicity* found its expression in the decision to introduce the "turtle", a "body-syntonic" cybernetic animal, which was introduced in order to concretise abstract ideas of computer programming, in order to provide a tangible resource in the hands of learners who would be able to explore ideas of computer science within the context of the turtle robot. The "turtle" was concrete and animated providing an engaging vehicle for users. Concepts from geometry were embedded in turtle graphics, and concepts from programming and problem-solving were used. The "turtle" was intended to be an easy entry-route to Logo for non-mathematical beginners:

> The most visible of Turtle Geometry's epistemological transgressions is bringing the body into mathematics. The turtle was chosen as a metaphor because it is so easy for a person to identify with it: You anthropomorphise the turtle: you solve a problem by putting yourself in its place and seeing what you would do (Papert, 1991:23).

Turtle graphics became the usual entry point into the language (*Mindstorms*, for example, uses the "turtle" a lot for this purpose) and this was clearly not a question of simplification, it was a question of embodiment. Yet, the introduction of the "turtle" became a contradiction built into Logo as it violated a fundamental principle of list-processing. The idea of list-processing (the most open-ended form of data typing in Computer Science) is a fundamental structure of Logo inherited from LISP. While previously in Computer Science one had programs and things the programs acted on (pieces of data), LISP abolished that distinction. Anything which was a program could also be a piece of data. Anything that was a piece of data could be considered as a program; a new way of doing things which was seen as inferring to the initiated user a tremendous amount of expressive power. Thus a procedure may modify itself and there is also the ability for primitives to be redefined:

In LOGO, procedures are manipulable entities. They can be named, stored away, retrieved, changed, used as building blocks for superprocedures and analysed into subprocedures (Papert, 1980:223).

This idea that everything you do has a result and the result of what you do can itself become the input to something new is a classical idea of the LISP designers inherited by Logo, very closely related to this idea of the programs and data being effectively the same. In this sense, from the beginning, the introduction of the "turtle" signified a contradiction between the design of the language and its rhetoric of open-endedness. Because when you instruct the "turtle" (typing, for example, FORWARD 50) and the "turtle" moves, there is no output, the output is the "turtle" moving. But the result of the "turtle" moving does not hand you back some computational object which you can then manipulate further. When, for example, you type FD 50, the "turtle" moves FD 50; from that point on you have nothing except for a visual representation of what happened on the screen. This, then, is an example of a contradiction built into the design of Logo: on the one hand Logo's creators felt the need to make the system more accessible to and usable by people, so they decided to introduce the "turtle"; on the other, they wanted this system to "mirror the elegance and aesthetic beauty of LISP" (and that is not only an aesthetic question, it confers on the initiated user a huge degree of expressiveness). Between the "turtle" and this potential for expressiveness, however, there came a barrier, namely the dominant assumption among Logo's users that Logo was actually only for turtle graphics.

I have shown in the discussion of the moment of production in Chapter Five that in its early days Logo was a very unstable product, in a sense that certain characteristics of the artefact (like the "turtle") had not been established as essential "ingredients" of this technology. Remember, for example, that Logo was initially built without a "turtle" with its emphasis initially being on algebra; the first research report (Feurzeig *et al.*, 1969) was about algebra while the turtle graphics microworld was introduced into Logo in 1970 when the first robot turtle was developed (Solomon, 1979:50). I have also illustrated how different "relevant social groups" -even within the designing teams- were attaching a multiplicity of interpretations of what this product ought to be. In addition, I have discussed some of the social mechanisms of "stabilisation" which brought about closure of this early multiplicity (or "interpretive flexibility"). Yet, as already mentioned in Chapter Five, the data gathered for this research suggest that the introduction of the "turtle" created some tension among Logo's developers and considerable confusion among Logo's users in a way in which even today there is still a question mark hanging over the original intentions of Logo's designers as far as the "turtle" is concerned: the very "text" offered the possibility of different "readings", users could "read" the "turtle" as being very limited, or they could "read" it as part of the bigger vision. As I will show in the discussion of moment 3 (*marketing/economics*) in Chapter Seven, this tension was continued during Logo's re-contextualisation into mainstream schools. In fact, while initially designers largely saw the "turtle" as a kind of physical embodiment of the algebra and geometry existing, very quickly the "turtle" became a focus of attention itself rather than a means to an end, creating a contradiction with Logo's design principles and feeding back to the processes of production (moment 1). This dominant "reading" that Logo was only for turtle graphics was so strongly established among (especially primary) teachers that -as I will show in the discussion of moment 3 in the following chapter-from being initially conceived by its producers as an entry route to the deep aesthetics of programming, the "turtle" eventually became a cul-de-sac as it was interpreted only as a means for drawing pictures. As turtle graphics were rarely featured in *Mindstorms*, we are led to think that some of the wider messages of the "Logo text" (both the language and its "philosophy" as encapsulated in *Mindstorms*) were rarely "read". Moreover, given that "progressive" ideas and methods had a limited profile in mainstream US and UK schools in the 1980s, we are led to think that, presumably, the "turtle" was the more easily assimilated message of *Mindstorms* in relation to the context of use, rather than the more "progressive" one; what was selected of the meanings present in *Mindstorms* was relevant to the context, which -as the discussion of moment 4 (*context*) in Chapter Eight will argue- was far from "progressive". How and why did Logo become synonymous with turtle graphics? What were the implications of this "reading" of Logo as turtle graphics in the context of use? It is to these questions that I will now turn.

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CHAPTER SEVEN

Marketing and economics in the production of Logo

1. Effects of marketing and commercialisation in the US context. In the early days (at BBN) Logo was not a commercial product; rather, it was a laboratory research idea. At that time there was no visible market and the sense of the researchers was that Logo would be an evolving system. Wallace Feurzeig, the leading figure of the BBN Logo research group remembers:

> Our sense was that it would be an evolving design... Our interest was not commercial at all, it was research (7).

The fact that BBN were never involved in the commercial marketplace with Logo is largely attributable to the fact that the company's orientation had always been towards getting involved in research on fairly sophisticated technical products for small numbers of users rather than towards low-cost products for a large number of users. However, the availability of microcomputers at schools in the early 1980s in the context of a "computer literacy" campaign (discussed in Appendix 1) brought in new players (e.g. hardware and software manufacturers) and commercial companies (most of them small) were established to exploit the school market that had appeared for Logo.

The launch of the Apple II microcomputer in 1977, and with it the *Apple* company, marked for many the new face of micros. This machine in particular represented the transformation to what was soon to be named the "Personal Computer", a term that was established in 1981 when *IBM* entered the market. A machine such as the Apple II could, in the US context, be sold as either business machine, hobbyist machine, home computer or, pretty soon, school computer. By the end of 1977 the Apple II had been joined by the TRS-80 machine from the retail chain *Tandy* (called *Radio Shack* in the US) and the PET computer from *Commodore*, a corporation previously known for its calculators. These three machines dominated the US market and they continued to sell well in the next few years. In striving for the extension of potential markets for their products- and before the decade was out- those companies eventually emphasised the micro as an "educational" machine for both the home and the school.

This strategy was more than an advertising ploy. Hardware companies commissioned and encouraged a range of educational software for their machines to run. In the USA, *Apple* was particularly keen to develop this feature. In the following years the industry witnessed the rise of software houses in a symbiotic relation to the hardware companies. And the educational pitch was stressed by the US semiconductor giant, *Texas Instruments* (TI). *TI* was unique in aiming solely for this new market, and not a hobbyist one or business one as well. Its educational machine was thought to capitalise on *TI*'s previous successes -the "Speak and Spell" devices and their follow-ups. Lastly *Atari*, the arcade and video games world leader, produced some machines and commissioned some software to support its educational identity.

All the software companies which commercialised Logo produced and marketed different versions in support of the various machines. There have been at least two kinds of companies which set out to commercialise Logo: on the one hand there were the existing, already commercially successful companies (like *TI*, *Commodore, Terrapin* and *Apple*); on the other hand, there were small companies which were set up exclusively to market Logo (like *LCSI* and *General Turtle*). With the exception of *LCSI* which has survived and is persistent for a long time, no other company of the second group ever became significantly commercially successful. Seymour Papert has been largely involved in it as the director and *LCSI Logo* has become the "official" version. *Apple Logo* was the first Logo version that was successful commercially when a lot of US schools got Apple II microcomputers making a significant market, whereas the PDP-11 machines hardly existed in schools before.

The commercialisation of Logo is considered by many to have been a mixed blessing. On the one hand there is the argument that the various attempts to commercialise aspects of Logo had the positive effect of making Logo available to a wider audience internationally, increasing the interest about and being a major vehicle for getting Logo into a lot of schools. Both M. Resnick and Dan Watt support this argument:

> Obviously the good thing is that it gets out to a lot more people, has a lot more influence on people who previously never would have thought of some of these ideas, get awakened, become meaningful contributors on their own right, either in their own local circles or getting connected to this larger community and starting influencing other people to think about these things. This was clearly a positive side of [getting commercial], reaching more people (20).

> My feeling is that nobody would have ever heard of it still if it hadn't gone commercial. It would be in pockets around the world as experiments (Dan Watt, 8).

On the negative side, it is strongly argued across the interviews that a significant effect of commercialisation was the rise of unrealistic claims about the value of Logo in the early days of its implementation at schools. Commercial companies advertised extensively using very often unsubstantiated claims for Logo, which were also raised at Logo conferences and in part of the early Logo literature. Al Cuoco, a curriculum developer at EDC, argues that an implication of this "overselling" was a widespread impression that "you give a kid Logo and you put it in front of the computer", the belief that children would make wonderful discoveries by themselves and the teacher almost does not have to be there:

> ...in many cases it [Logo] was oversold... there were just grandiose claims for this environment... the opposite was true, teachers are central to such a thing, the way the language was used was central to the whole success of the operation (5).

2. Logo becomes "a language for babies". Another early effect of the way Logo was advertised and marketed by commercial companies was that it quickly became regarded as a programming language for young children. The fact that Logo was *represented* as a "baby language" was a conscious marketing decision dictated by the reality of the new promising market, elementary schools. Within the context of the pressures put on schools to acquire and use computer hardware and software, and given the predominance of languages like BASIC and PASCAL which were traditionally regarded as more suitable for more advanced applications, Logo companies self-consciously targeted their product to the part of the new market which was not colonised by other languages, that is elementary schools. As Cuoco remembers, in order to make a reasonable commercial success Logo was consciously aimed at young children:

> Logo was being looked at as a language for elementary school students. By-and-large this was a product of the way Logo was advertised and marketed. We were constantly battling with people in the community and parents against this impression that Logo was an environment for little kids. And that was the reputation it had built up in this country anyway, that it was something for elementary school kids. And that high-school kids should not waste their time with this language that was basically for little kids. I think it had a lot to do with the way Logo was marketed as a product by the companies. Most of the workshops that you would see advertised at conferences and so forth were how to use Logo in elementary schools. In the early days of using Logo there was a very clear emphasis to get kids interested in mathematics at a very early age and lots of people that I talked to were really surprised to find out that Logo could do things other than produce pictures. The fact that it was a dialect of LISP and all this other stuff came as a big surprise to most people that I talked to (5).

The view that Logo became a "baby language" mainly due to commercial interests is also supported by Uri Leron, a professor of Mathematics Education at the Technion

University of Haifa, Israel, who has been an important figure in the evolution of Logo in the early 1980s:

> ...mainly because of business consideration Logo was never developed very much for... high school students, let alone university students. And people like me and like Brian Harvey who worked a lot with [university] students were frustrated by the fact that LCSI didn't produce versions of Logo for this audience. And the reason for this was simply because this audience is very small. There are very few people in the world who teach Logo to older children. Most of the market is in the elementary school so they directed the product to the elementary school and we remained with very old and outdated versions (13).

In close articulation with the commercial decision to market Logo as a programming language for the lower grades, the fact that the standards developed for the US Advanced Placement Exams (APE) scheme for college credit were based on PASCAL (which was the dominant programming language at the time), reinforced the dominant "reading" of Logo as a "language for babies" and its deeper institutionalisation as part of the lower grades curriculum:

> In the United States, the Advanced Placement exam in computer science, leading to college credit, has had a beneficial effect on what language is used... The Advanced Placement exam requires a structured language, Pascal. Because over 95% of introductory university computer science courses are based on Pascal, it is not surprising that the APE in computer science uses Pascal (Bork, 1993:75).

The decision to have Pascal as the standard language for APE constructed a sense of superiority around it and it made it look more advanced language than Logo which was thus viewed as not appropriate for higher grades. As PASCAL remained the standard currency for getting college credit for High School work, Logo did not have the same exchange value for high-school students. Uri Wilensky recalls:

> As a result, people believed Logo should be for kids (in the kids grades) and then you grow up to do C, PASCAL, FORTRAN or even BASIC, whatever it is that they think it is the next computer language. So I guess school assimilated it to be just like other computer languages as except for young kids (24)

3. The issue of "flashiness". The decision to hold elementary schools as the primary target for Logo automatically meant that the equation *more "flashiness" = better sells* (that is increasing sells via making the product more attractive to its particular target audience) was a necessary strategy for commercial companies. It seems also that -to some extent- the original developers of Logo unwittingly had created the impression that Logo was a means for creating graphics after their adoption of the "turtle" (discussed in Chapters Five and Six). Perhaps Seymour Papert's emphasis on turtle geometry in *Mindstorms* has also played a role in enhancing such an interpretation of Logo in a sense that the marketing people themselves made a "selective reading" of *Mindstorms*. This *representation* of Logo at the moment of marketing as an attractive way for creating graphics (that is the representation of Logo as an activity, rather than as a tool) itself fed back into the expectations of the producers of what Logo ought to be and to a certain extent into what it became (fed back into the moment of production). Given, however, the limitations of the technology at the time, "flashiness" was added on at the expense of other features of the language. A good example of how a version of Logo was shaped by this commercial drive to provide more attractive effects is the case of *ExperLogo*, a version for the Macintosh which was developed in 1985. *ExperLogo* was advertised as being incredibly fast and speed was promoted as an aesthetic worth pursuing. However, the price paid for the speed was that the computer did graphics only in whole numbers. For example, if you typed FORWARD 7.4 the "turtle" moved only FORWARD 7. Or if you typed REPEAT 10 [FORWARD 0.1] the "turtle" didn't move at all. This meant that the producers of *ExperLogo* were prepared to sacrifice the aesthetic of mathematics and consistency for the aesthetic of speed. This process of compromising the commercial drive for "flashiness" with some of the original design principles of Logo is sharply illustrated by Papert (1987):

> What is beautiful for the designers of ExperLogo is the speed of their bunny. I, too, would like speed... and an ideal implementation of Logo... But in the real world there is no such thing as an "ideal" implementation of a computer language. At the core of the process of design is the art of trade-off. If you want more speed, you have to take less of something else... Observing what a design team finds worth giving up is a window into its aesthetics and its intellectual values. The bunny gains speed at the cost of a kind of intellectual power that may be of no consequence to a professional programmer working on expert systems, but could be highly consequential in shaping a child's computer culture...
>
> In ExperLogo, bunny speed was bought (in part) at the cost of making FD treat its input as an integer. So, 0.1 is simply treated as 0. REPEAT 100 [FD 0.1] is the same as FD 0. Thus the relationship between Logo and mathematical intuition is impaired, and the passage into mathematics through the turtle circle is impeded... What kind of decision did the ExperLogo team make in choosing speed over mathematical transparency? The point is not whether the choice is right or wrong but what it tells us about the decider... The designers of *ExperLogo* have the right to give higher priority to speed. But this *is* a choice. And each choice is a reflection of cultural affiliation (Papert, 1987:64, original emphasis).

Even today, the commercially-driven legacy of "flashiness" is evident in one of the latest versions of Logo, *Microworlds Logo,* which has sacrificed some of the original aesthetics of Logo for the aesthetics of "flashiness" although most of the technical limitations of the past (e.g. limited memory capacity) have been overcome. It seems, however, that the appearance of other kinds of commercial software in the 1980s which had attractive features like colour and sound effects put pressure on commercial companies to create more "flashy" versions of Logo which would otherwise be "a very hard sell". This was basically the reason which led to the development of *LogoWriter* by LCSI in 1986, a version of Logo which combined graphic design capabilities with a word-processor and other attractive features. The combination of drawing with word-processing capabilities and a number of other features allowed many more different possibilities and it was a conscious decision on the part of the producers to broaden the appeal and show that Logo could be used for many more things and in many more ways than turtle graphics. However, the conscious commercial decision to add new attractive features like animation had -in this case, too- its cost as it implied that the resolution of turtle graphics had to be sacrificed for "flashiness", something which was bad news for those who were trying to develop the use of Logo for mathematical and geometrical work. Molly Watt remembers:

> When LCSI came out with *LogoWriter* it broadened the appeal and "killed the mouse", and harmed the mathematical side of Logo... It essentially de-emphasised a lot of the mathematics of turtle geometry for example. Because one of the things they did in the first implementations of *LogoWriter* was they gained features in the Logo program by reducing the resolution of the turtle graphics. The lines were thicker, so you couldn't draw such interesting graphic designs anymore. That's just a very small point of how a decision to add attractive features -these little animations and things- to Logo interfered with some of the... They brought out something very new and very flashy... There became so many different possibilities that it was trying to be everything. And so it maybe spread itself too far. They brought out something very new and very flashy and very exciting and very marvellous. But I wish they had waited five years to bring it out. Because we were just beginning to develop what could be done with turtle geometry as a broader culture. And a lot of people just threw that stuff out (Molly Watt, 23).

4. The tension between the MIT Logo Group and the Apple company.

Similarly to the development of *LogoWriter*, the following tension between the *Apple* company and the MIT Logo Group illustrates how specific commercial decisions influenced the shaping of the Logo artefact. In 1981 the MIT Logo group developed an implementation of Logo for the *Apple* computer. *Apple* wanted to have the exclusive rights for the distribution of this new product. However, after consulting with lawyers for a long time, MIT decided that *Apple* should not have the exclusive rights on that version (because initially Logo had been developed with public funding) but, rather, that -similarly to any other Logo version- this version for the Apple microcomputer should be freely licensed to anyone who would distribute it. The tension was resolved with the establishment of Logo Computer Systems Inc (*LCSI*) as a separate company by a group of investors and the creation -by the LCSI- of a new (second) version of Logo for the *Apple* computer which was finally bought by *Apple*. Seymour Papert became the director of *LCSI* and many of the same people from the Logo Lab were hired. The two Logo versions for the Apple microcomputer were almost identical, with only a few minor differences which provided the legal ground to consider them "different" for copyright reasons. *Apple* bought the exclusive rights of the "new" version which thereafter became *Apple Logo*. That was an acceptable settlement for both sides: on the one hand, LCSI continued to develop the original version; on the other, *Apple* were gratified to see that by summer 1986 approximately 150,000 copies of Logo had been sold for the Apple II family of computers in the US and Canada, which meant significant profits. Further evidence suggests that this decision to produce the second version (for *Apple*) was not based upon educational reasons having to do with progression in the development of the language; rather, it was essentially a commercial decision. Dan and Molly Watt recall:

> If you talk to some of the other people like Brian Silverman they may tell you that the MIT version of Logo had some mistakes in it and things they didn't like, which is true. It wasn't debugged enough and they wanted to make a few choices on it, a few commands. They did have some more powerful commands in the Apple one. **But it was essentially a marketing decision this whole issue of different versions of Logo and different implementations** (23, emphasis added).

5. *Texas Instruments* and the sprites chip. Another example of how commercial decisions shaped the evolution of the Logo-product is the case of the *Texas Instruments* (*TI*) sprites[69] chip. At the time *TI* computers had a graphic capability that other computers did not have and this was making available the Sprite animation on the *TI* computers. The chip for the Sprites was not available for other computers and *TI* for some time would not sell it to other computer companies. Eventually *LCSI* bought the graphics chip from *TI* and put it on a special board to make the *Sprite Logo* on the *Apple* computer:

> So if you wanted to get the Sprite Logo on the Apple computer you had to pay another $200 to get the special board to stick in your computer. That was a big deal! It was an extra step and a lot more money! (23)

6. Cut down versions. It is also significant for our discussion that in their attempt to make Logo available on the first microcomputers (which had very limited capabilities), commercial companies produced seriously cut down versions. A great many of the very first implementations of Logo on the *Apple* were seriously cut down. This fact enhanced the impression that Logo was suitable for elementary schools only. As a lot of the more advanced kinds of things that one might want to do were simply not possible with the cut-down versions (like the ability to file data), BASIC featured as a more serious language for high-schoolers. As Goldenberg and Watt remember:

> you just couldn't do with [these cut-back versions of] Logo the kinds of things you wanted to do ...so that plus the advertising toward young kids may well have **killed** Logo for older kids (8).

7. Commercialisation/implementation vs. technical development. An additional consequence of the involvement of commercial companies was the creation of tension within the MIT Logo Group itself because -as I have shown in Chapter Five- a number of people in the group were in favour of more research and technical development of Logo instead of commercialisation and school implementation which was what the commercial companies wanted. The fact that people from the Logo research group became affiliated with both the research team and the commercial companies seemed to slow down research in favour of commercialisation and implementation, a direction which -as I have shown in Chapter Five- was not preferred by those members of the Lab who were in favour of research and technical development. Lieberman remembers:

> The attempt to commercialise created some tension as the companies took people away from doing research so the research group felt like some of the resources were being taken away to commercial companies. There were also individuals who had conflict of interest as they were affiliated both with the [MIT] research group and commercial companies. This surely hap-

pened with the first company "General Turtle"... there was some uneasiness about who was involved in this company and who was not, also about to what extent the company was using resources of the Lab... we thought, that if the company was successful that would be a good thing for Logo. But there was always what the priorities were for the research versus the company... When you get that kind of situation it always influences the development in that it sort of puts more emphasis on short-term objectives rather than long-term objectives (14).

The view that commercial companies caused tension among the members of the research community that were involved is also supported by Brian Harvey:

...There was a kind of fragmentation of people's efforts... There was Terrapin, and LCSI... and those companies came out of the same group of people, the MIT Logo Lab people. And there were other smaller companies... It's hard to support all those different companies and people... and sometimes there are rivalries. So in the case of Apple, there were two different competing versions of Logo for the Apple... There was the LCSI Logo and there was Terrapin Logo which was the one developed at MIT by Hal Abelson's group. And that was too bad because sometimes people didn't like each other, it was also too bad because the two versions were incompatible... (10).

The existence of commercially antagonistic versions created tensions within the context of "consumption", too, as the commercial companies forced those responsible for dissemination and implementation to take sides. These pressures were a divisive element within the wider "Logo community" as well as confusing for teachers who were using Logo at schools. Dan and Molly Watt, curriculum developers and teacher trainers in Logo, remember:

There were these different versions... and most people had their feet planted in one or the other... we refused to take a position on which one, we would always try to do things that were common. [This] made us not so popular sometimes as Seymour and people who had a financial and a personal interest in this version or that version. We were always trying to show the universal thing that could be done... But we **never, ever took a position of which one**! And that made us incredibly unusual. And people would get quite angry at us about not being either for *Terrapin*, or *LCSI* or... we didn't ally ourselves with any of the companies, so none of them would have loved us entirely although they all were very generous to us (23).

The antagonism between versions was also causing practical problems for teachers who were either learning to use or using Logo at schools:

And if you had a group of teachers and you got them trained in using the Terrapin Logo, you couldn't go and the next year take the other one or whatever. And the same applied to computers. If you used the TI computer, for example, it was very difficult to switch over and use something else. So that was a very divisive element (23).

Beyond the commercialisation and marketing of Logo in the US context, the study of the re-contextualisation of Logo in Britain in the early 1980s provides a window into the social processes involved in Logo's production and marketing as well as into the important ways in which "consumption" was partially determined by the decisions involved at earlier stages in the cultural circuit.

8. Linking production to "consumption" through the nationalist sell: politics and economics in the production of Logo in the UK. Logo appeared on the British scene in the early 1980s. The discussion of the social and political context of the time in Appendix One shows that Ronald Reagan's demand for educational quality in the USA was paralleled in Britain by Margaret Thatcher's call for a return to "Basics" and also by the Education Secretary's paper on "teaching quality". Within this context, a similar attitude in the educational policy of both the US and the UK demanded a rapid introduction of computers in education by funding national initiatives to place computers in schools. In the UK context, the Department of Industry (DoI) subsidised the introduction of "home-made" computers to both primary and secondary schools while a massive training campaign was launched to teach teachers the basic skills thought as necessary for operating the micro in the classroom.

British initiatives began in 1980 with the Department of Industry's Micros in Schools scheme, followed shortly by the Department of Education and Science's Microelectronics Education Programme (MEP)[70]:

Provision of computers in schools was entrusted to the Microelectronics Education Programme, a government agency; in common with many countries at the time, the UK government saw their role as equipping schools with machines first, and only secondarily to aid in the process of deciding what to do with them (Noss & Hoyles, 1996: 161).

Under the MEP scheme, secondary schools were offered half the cost of one of two British micros, one of which did not actually exist at the time the scheme was announced. The scheme was later extended, in a slightly modified form but still with the patriotic clause, to primary schools, special education schools and teacher training colleges. These various schemes had cost the government about £30 million by the end of 1983.

As Appendix One also argues in greater length, however, interests other than straightforward educational ones determined the kind of hardware and software as well as the overall character of the attempted innovation. Both existing literature and research evidence from data collected for this study strongly suggest that the impetus for putting micros in the schools came from industrialists rather than educationalists. For example, Janet Ainley, a mathematics teacher in the UK at that time (today she is a member of staff of the Mathematics Education Research Centre at Warwick University) remembers:

It was time when computers were first starting to come into schools and schools wanted to get hold of this new thing and... "there is this very good...offer". But what was on offer was only British-made computers... The motivation was nothing to do with education, it was actually about supporting the British computer industry (2).

In the literature, Self (1987), Doyle (1993) and Noss & Hoyles (1996) have also registered this point sharply as the following quotation from Self (1987) shows:

The DoI schemes have played a notable part in sustaining the indigenous microcomputer industry. The apparent benevolence to the educational system cloaks a multi-million pound subsidy to manufacturers which would have been politically unpalatable if given directly. In 1981, American micros, with their greater software support, were beginning to predominate in British schools. Now they and Japanese micros together, of course, with non-recommended

British micros are virtually excluded from British schools -so much for the free market economy! (Self, 1987:230).

Guided by the policy imperatives of centralising curriculum control and the rhetoric of high-technology business interests, the British Government was poised for a major intervention which was clearly intended to convey a number of symbolic messages: that the government was on top of things, that it was in control and that it was "out in front" of this important development. The initiative was also surrounded by a justifying rhetoric couched in terms of international competitiveness, the needs of business and, only lastly, the possibility of enriching students' lives. The process of mandating a standardised form of educational computer had to be carefully managed, in order to avoid the appearance that Local Education Authorities were actually being ordered to do something. The approach that was taken, in the end, was not to openly impose a particular computer configuration, but to "recommend" and to make the selected system so economically attractive as to rule out any other alternatives on a cost basis alone. Different interviewees stressed this point when talking to me about the development of Logo in the UK which in the early 1980s went alongside the introduction of computers in education. J. Ainley (already quoted above), M. Doyle (Chair of BLUG), J. Wood (Imperial College) and Richard Noss (Institute of Education), all of them active players in the take-up of Logo in the UK in the 1980s, remember respectively:

There was a Government initiative in the 1980s to put a computer in every school. And schools were able to buy at quite reduced prices and **obviously** a lot of schools did that. And lots of Local Authorities did the same on behalf of the schools... And what was on offer were BBCs and Sinclair Spectrum and the 480Z Nimbus machines... and so that was what schools bought (2).

...a government decision to support UK industry by way of controlling the market. Schools were not allowed to buy other than a specified range of computers initially, and the rules weren't relaxed until the later 1980s. A school could buy anything they liked but they got a subsidy from the government if they bought either Acorn or RM [Research Machines]. And when government initiatives came out initially they would only support... they said: 'you can buy from the following range of computers' (6).

Because there was a politically inspired government initiative to supply computers into the schools, which effectively defined the computers that were going to be in the schools. We had a choice between a CPM [operating system] machine (a British machine made by Research Machines), and the BBC computer (26)

British government -always interested in boosting British industry- decided to give every school a computer, they decided to back a little company called *Acorn* and allow it to use the name *BBC*. And the outcome of all this was that taxpayers money was used to subsidise it (16).

At the hardware front then, this politically inspired and economically motivated hardware prescription effectively defined the computers that schools were allowed to buy. The possibilities and limitations of the hardware chosen, in turn, defined the sort of software that would become available to schools: the versions of Logo that would become available to British schools had to be compatible with the "recommended" hardware:

It [the introduction of Logo] went alongside the introduction of computers because the versions of Logo were developed for the machines that schools were buying (2).

However, while schools (especially primary schools) "chose" the BBC computer, there was no Logo implementation available for this computer at that time. As Mike Doyle and Richard Noss remember, the BBC microcomputer had BASIC as the standard language built-into it:

So that when you started up the BBC computer both the operating system and the BASIC language were there available for you from the world go (6).

The interesting thing is that along with this silly little machine [BBC] there was also a version of BASIC, a 'new improved wonderful [ironic] version of BASIC called 'BBC BASIC' (16).

As *Acorn* had invested heavily in its own "improved" variety of BASIC for the BBC computer, the company had a big vested interest in not having a version of Logo, because they wanted to sell BASIC as the most wonderful thing in the world. BASIC was already established as a programming language, it was much easier to sell a new version of BASIC than a completely new language:

...as a result, there was little incentive for the company who manufactured it to develop a viable Logo (Noss & Hoyles, 1996:162).

The BBC BASIC was a structured BASIC which allowed you to do recursion at least in part. This meant that people could write turtle graphics programs (that did the "turtle" part of Logo but not the list-processing part) for use on the BBC computer and also on the *Research Machines* computer for which there also was not a Logo in the very early days. This meant that in order to do any Logo at all one had to write an emulation of Logo in BASIC. Mike Doyle, a teacher at that time, remembers:

And I didn't use Logo because I had a BBC computer, I used the emulation of Logo called DART... And when I got my BBC computer I taught myself BASIC, because that was the language that came with it (6).

When Logo implementations for the BBC did become available later, technical constraints were a serious factor discouraging schools from buying some version of Logo for the BBC machine. For example, Doyle remembers that the BBC machine had a very low memory capacity and it could not run Logo properly:

And I wouldn't be able to write Logo properly because the BBC computer wasn't powerful enough at that time for me to write a Logo program of any complexity... The difficulty was that Logo was too big a language for the computer with which I was working (6).

To be able to do so an additional new kit had to be installed on the computer, a technical constraint which -as Richard Noss recalls- discouraged teachers even more:

... it had to have a new kit installed. So it was very tricky, you had to be really committed. If you wanted to buy that version of Logo for ten machines you had to buy ten new chips and install them without bending the pins, that was a nightmare (16).

In 1984 four implementations of Logo for the BBC computer became available. Out of these four, two Logo versions were competing effectively at the time: one written by *Acorn* themselves and one imported from France, *Logotron Logo*. The *Acorn* one required two holes (two chip sockets), the Logotron one required one socket at the back of the computer. *Logotron Logo* was eventually adopted as it required only one chip. As Doyle suggests in the following quotation, once again, the Logo version that came out on top did so not due to its educational merits but due to reasons having to do with the technological nature and limitations of the BBC computer:

And in the BBC computer at that time there were two spare holes, you put a word-processing chip in one and you put Logo in the other. And if you needed to use two holes for your Logo you couldn't have a word-processing chip in. And so it's won out for that very simple reason that it only took one hole. It wasn't the best implementation... In effect this in a way determined the kind of Logo that came to be used in [British] classrooms. You had a spare hole, 'which one fitted in the spare hole? which one was fairly standard? why don't we go buy that one? (6).

In the meantime, however, the delay in producing these versions of Logo for the BBC machines already bought by schools (the gap between 1982 and 1984) had some surprising effects, the legacy of which still exists today: several individuals, amateurs, saw a wonderful opportunity to make money and produced little graphics-drawing packages usually written in BASIC (one of them was *Logo-Challenge*, another called *DART*) which were called "Logo". As Richard Noss and John Wood remember, these packages were offered at attractive prices and caused confusion among teachers, a point also registered in the literature as the third of the following quotations shows:

But these other ones were called 'Logo' and how do you know? If you are sitting in an infant school and somebody says 'would you like a copy of Logo-Challenge?' and it's only £ 3.50 and you also get a book on what to do with it... And even now there are people who don't understand (16).

A lot of things like DART, of qualities lesser or greater than DART, were called 'Logo'. I guess that teachers ended up quite confused. There was no message that could be coming through from this (26).

This mildly interesting accident of marketing and economics had some surprising effects. It created a serious gap between the sudden flash of interest in Logo's potential, and the ability of children in schools to actually use it. Into this gap stepped a number of 'turtle drivers': simple programs (usually written in BASIC) designed to draw graphics using a screen turtle; the most successful of these was DART (still in use in the mid-nineties, -inertia indeed!). All of these programs allowed the child to drive a turtle using FORWARD, RIGHT, etc., none of

> them had recursion, list processing, proper control structures, arithmetic operations or serious screen editors. Yet some (not, thankfully DART) happily packaged themselves with the title 'Logo'[71] (Noss & Hoyles, 1996:162).

In 1983 the British Logo Users Group (BLUG) referred a number of these products to the Trading Standards. Mike Doyle, the current chair of BLUG recalls:

> And we received a letter back from them that said: 'There seems to be a general acceptance within the trade that the use of turtle graphics is equivalent to Logo' (6).

This meant that by 1993 -legally in the UK- Logo and turtle graphics were effectively regarded as the same thing. From being a computer language of interest to education, Logo in the UK had become equated to a language for turtle graphics. In 1985 DART was being used quite a lot for this purpose. At the same time, while the chip required for the installation of Logo cost £75, DART was a freely copyable package available from local school computer centres free of charge:

> And the only bits that mathematics teachers were talking about teaching were turtle graphics... And therefore people tended to buy... -they didn't have to buy DART- they got hold of it and tried it- and then said 'this does what I want, why do I have to go and buy the real thing for £75?'. Because when they bought the real thing they didn't use any of the characteristics that make Logo a particular computer language, they simply used it for turtle graphics (6).

It is instructive to note that -as the following quotation from my interview with Bill Tagg (then director of the Hatfield Advisory Unit which had developed DART) indicates, in the manual accompanying DART its developers had written that when Logo became available teachers...

> ...should bury this software [DART] gratefully and buy the full version of Logo. But they didn't. At least a lot of them didn't, a lot of them continued to use DART. And in fact when Logo became available on the micro we stopped selling DART. *And after a couple of years we actually started selling it again because there was a huge demand for it, people were very angry* (21, emphasis added).

As a result,

> DART, not Logo, was the formative experience for teachers in the UK -the philosophy without the language through which it was expressed. Consequently, the notion of Computer Language degenerated to 'precise sequences of instructions'. Logo became little more than "Turtle Talk" (Doyle, 1993:22).

Beverly Anderson's evaluation report *Learning with LOGO*(1986) on classroom experiences commissioned by the MEP supports Doyle's argument in showing that:

> ...programmable toys such as Milton Bradley's *Big Trak* were seen as "Turtles"; turtle graphics programs written in BASIC, such as DART, were not distinguished from Logo; and Logo itself was viewed as difficult, expensive, and (possibly) not necessary for doing Logo (Doyle, 1993:24).

Anderson's report confirmed that, in one form or another, "Logo" had been rapidly taken up in the UK, yet in a manner that had become acceptable to teachers and to the system[72]. Noss & Hoyles (1996) provide a double explanation of this mode of "consumption" arguing that two contradictory processes were at work. On the one hand, they argue, the introduction of cut-down 'Logo' resonated with the child-centred approach which had come to characterise many English primary schools in the nineteen seventies:

> ...teachers, parents and head teachers could view "Turtling" as happily fitting into the wide variety of 'child-centred' activities which could be found in many primary classrooms (Noss & Hoyles, 1996:162).

On the other hand, the very success of Logo's assimilation led to its being viewed as an "activity" in its own right, not a way of introducing radical change but as a way of operationalising existing priorities by an "added on" school topic rather than one integrated into the educational setting. By being equated to turtle graphics and incorporated as a minor activity among many others, Logo was fitted comfortably into existing school structures:

> So Logo became a way of ordering turtles around the screen. Turtle drivers such as DART shaped the attitudes of a generation of primary and secondary teachers, and at the same time, such programs were conjured into existence to express these attitudes and priorities. Drawing pictures with a turtle became a new curricular compartment. Logo became *marginalised* by its very incorporation -everything had changed but nothing had changed. (Noss & Hoyles, 1996:163)

9. Conclusion. It may be tempting to think that once Logo leaves the research laboratories where it was initially developed, there is little left to say concerning its meaning. However, analysis of moment 3 of Logo's circuit (*marketing/ economics*) in this chapter suggests that this is not the case. Although we have already seen (in chapters Five and Six) how particular cultural meanings were ascribed to the artefact throughout its design process, surely there is a lot more to say about what happens to Logo -and, in fact, to any educational innovation- in the subsequent involvement of mediators until the artefact reaches the classroom. Logo was not simply presented from the beginning (moment 1) as a device for turtle graphics -it *became* this through a process in which "production" and "consumption" were articulated. The technology was not simply produced as a finished artefact which was then marketed and simply had an impact on "consumption". The activities of mediators like government departments and the domestic microcomputer industrial lobby were crucial to the modification and redevelopment of Logo.

The discussion of the re-construction of Logo as turtle graphics , especially in the UK context, in this chapter has illustrated how the decision to introduce the "turtle" as an easy entry-route to the language resulted in a tension between intentions and effects (an argument already put forward in chapters Five and Six). This was actually made possible by Papert's own emphasis on the "turtle" in *Mindstorms* (moment 2), but then commercial considerations led to the foregrounding of that and the marginalisation of other messages in the "Logo text". We can see now more clearly that the tension over the introduction of the "turtle" was not resolved at the level of initial production; rather, it is an issue which cuts across "moments". Once again, what we witness here is that the struggle over the meaning of Logo was not confined only between the original producers of Logo in the early days. Rather, it echoes all the way through the different "moments" in Logo's circuit and, therefore, it is not just a question of stating and re-stating in each chapter of this thesis. What each chapter shows is that the struggle is present and it is re-contextualised, arriving therefore at a slightly different "settlement" each time in a different context; but the nature of the previous "settlement" becomes part of the cultural resources involved in reaching the new "settlement".

The dominant construction of Logo as turtle graphics at the level of marketing and economics fed back powerfully to the production stage, forming the background for new production. A proof of this is that twenty years after the introduction of the "turtle" a new version of Logo was designed (not even called "Logo" because of the political fall-out of calling a new piece of software "Logo", see Appendix Eight) whose main claim is that it is easier than ever to draw with (*Microworlds Project Builder*[73], a glorified drawing tool with programming language built-in); in the current stage of play, the equation *Logo=turtle graphics* is still winning.

The dominant representation of Logo as turtle graphics had significant implications for the "consumption" of Logo in real classrooms (moments 5). The question now arises of the extent to which the restrictions that such a powerful construction placed on what would happen at the level of "consumption", determined that moment. Evidence suggests that this power of the social context of use has not been absolute, hence my hesitation to impose a totally deterministic model of explanation. Chapter Nine will show that despite the pressures and the dominant conservative use there can be -and, in fact, there have been-' exceptional "success stories" (that is examples of radical use of Logo) which came much closer to the initial expectations of Logo's developers as these were discussed in chapters Five and Six. These trade on what is the "submerged" or "latent" meanings of Logo which were still present in the "text" to be realised in favourable contexts even though in most contexts the "settlement" has privileged the more conservative use. Before the discussion of "consumption", however, Chapter Eight will provide a discussion situating the introduction of Logo to mainstream schools within its social and political context.

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CHAPTER EIGHT

From Progressivism to the Conservative Restoration: the social and political context of Logo's introduction to mainstream schools

1. The US context. Chapters One and Five, together with Appendix One, have pointed to the fact that Logo was initially developed in the US in a decade characterised by immense support for maths and science teaching following the Sputnik-shock. The emphasis given to the teaching of science and mathematics in the immediate post-Sputnik years provided a conducive background for technological innovations that promised to make this teaching more efficient:

The post-Sputnik crisis in the 1960s spawned the development of large-scale curriculum innovations and the advocacy of inquiry-oriented and student-centered instruction. It was a period of new math, radical revisions in chemistry and physics, open education, individualized instruction, and so forth.... Innovations, the more the better, became the mark of progress (Fullan, 1991:5).

What is more important for us here is the fact that that was also a high time for "progressive" education in the United States; US education of the late 1960s seemed on the verge of a renaissance commensurate to the era of progressivism of the 1920s and 1930s:

Practical innovations dotted the landscape; experimentalism from Montessori to free schools, often student controlled, succeeded in forcing a modicum of school reform in the public sector from the outside. At the beginning of the 1970s, education officials in cities and towns throughout the country had decided that it was necessary to create alternative elementary and secondary schools *within* the established order. The motivating power for starting these programs was by no means altruistic or a far-sightedness by educational professionals. They were simply persuaded, either by the example of successful projects outside the system or the eloquence of educational planners and critics, that certain problems of the schools could at least be ameliorated, if not solved by educational innovations (Aronowitz & Giroux, 1993:55).

Building on the example of the community-controlled districts in New York elementary and junior high schools, big city Boards of Education moved into the new decade with plans to encourage neighbourhoods and educators to begin experiments in alternative high schools as well. The legitimacy of schools as educational institutions was challenged by low attendance and plummenting test scores. Parents, especially those from minority communities and the remaining white middle class in the cities, began demanding educational changes, the content of which remained unspecified. The ideas of Neil Postman, George Dennison, Jonathan Kozol, Charles Silberman and other writers were seriously considered in the quest for stability in schools. Thus "progressive" possibilities came to accompany the late 1960s and the beginning of the 1970s with a new literature on the death and re-birth of education bursting on the scene. As a result, a number of teachers who were sensitive to social and political injustices were able to supplement or undermine the biases and narrow world views that an increasingly standardised and instrumental curriculum offered. Some teachers broke from the instrumental, non-political, non-intervention role of schools to use education for social change and enrichment. To supplement narrow or biased texts, those "progressive" teachers drew from instructional materials and used the civil rights movement, feminism, the anti-war movement, alternative school projects, media education, and other marginalised curricula to offer their students alternative perspectives and expanded world views. Similar to the social re-constructionists of the 1930s, who felt education could be the cornerstone of a new social order, were those teachers who viewed the purpose of education in the 1960s not as training grounds for the needs of industry and a capitalist economic system, but for the needs of a democratic and just society.

2. The context in Britain. Around the same time in Britain, at a time of relative prosperity and low unemployment, at a time of increased emphasis on the individual's right to self-determination -to choose, to think, to decide for oneself- (an idea which in the 60s had the power to appear radical, threatening and news-worthy), at a time when new universities were springing up, at a time when optimism was in the air, the preconditions for a "golden age" of "progressive" education -one that probably never existed- were complemented by the "licensed autonomy" from political control which the education system enjoyed during the 1960s:

> ...the three major sets of condition necessary for the systematic implementation of progressive methods in State schools were present by the early 1960s -economic prosperity and an accompanying increase in resources for education; growing ideological acceptance in key areas and institutions (such as local inspectorate and training colleges); and an 'elective affinity' with the political grouping which dominated education (Dale, 1979a:194).

In the context of an expanding education system (partly because of the expanding school population, partly because of the increased significance placed on education in liberal/social democratic ideology) "progressivism" was gaining ground, developing in the context of teacher autonomy and expanding resources. It was seen to provide spaces within which the actions of even small groups of teachers and pupils could assume significance out of proportion to their size and scope. In 1967, the *Children and their Primary Schools* report on primary education (widely known as the *Plowden Report* for England[74]) was declaring -among other things- that "the child is the agent in his own learning", that "finding out" was better for children than "being told" and that education could compensate for society, marking what Hofkins (1997:2) calls "A golden age when Utopia was a possibility". The Report set out its ideal in a language of sparkling optimism and touching belief in social engineering:

> The school sets out deliberately to devise the right environment for children, to allow them to be themselves and to develop in the way and at the pace appropriate to them. It tries to equalise opportunities and to compensate for handicaps. It lays special stress on individual

discovery, on first-hand experience and on opportunities for creative work. A child brought up in such an atmosphere...has some hope of becoming a balanced and mature adult and of being able to live in, to contribute to, and to look critically at the society of which he forms a part (CACE, 1967)

The effects of the report are difficult to summarise. Partly because of its very positive stance, the report was criticised by many practitioners for being far too utopian. To many, Plowden's aspirations, both for them as teachers and for their pupils, appeared utterly remote and unrealistic; to use Sixties' language, it probably put off more teachers than it "turned on". In too many cases its advocacy of what it considered excellent practice militated against the generality of practice advancing towards what it would see as good. The value it placed on the individual led, in many schools, to an undue emphasis on individual learning, impossible to implement effectively in all but very small classes, and denying too many children sustained interaction with the teacher and other pupils. A small minority of teachers *did* effectively abdicate their responsibilities for teaching. Too often more attention was paid to the niceties of classroom layout, display and learning environment and not enough to the content of the curriculum or the means by which it might be taught. The *laisez-faire* curriculum of the Seventies and early Eighties owed much to the lack of a clear lead from the Plowden Report. According to Richards (1997:3), there was no significant "primary school revolution" along Plowden lines; the "quickening trend" it identified failed to materialise.

For some other teachers, however, the Primary Memorandum in Scotland (SED, 1965) and the Plowden Report (CACE, 1967) provided a perennial source of inspiration, a view of what might be possible "in the best of all possible worlds". Their support for individuality and creativity led to some outstanding work by individual schools or teachers which demonstrated how untapped by conventional schooling is the potential of so many children. They provided powerful support for the abolition of selection and they helped remove the widespread practice of streaming by ability and the inequalities and waste that system of internal organisation had wreaked. They transformed the physical layout of many schools and classrooms. In general, the two reports contributed to an exceptional context in which primary schools operated, albeit for a short time only. They symbolised changes occurring at a time when government was beginning to think that research could enhance policy-making and practice: for a few years primary education was regarded by government as a particularly important stage in the educational system and primary teachers were made to feel valued and good about themselves and their profession.

3. Logo and progressivism. In retrospect, its is clear that the optimism of the Primary Memorandum and of the Plowden Report was largely misplaced and that the reports never had much influence on teachers' classroom practice. In their time, however, the reports inspired some young teachers who believed that learners had to be autonomous, have to be highly motivated to learn, and that little children are perfectly able of taking charge of their own learning. As a "progressive" teacher says today:

Plowden was about the real, the handling, the unexpected (Gold, 1997:6).

Within this context of increased possibilities for "progressive" work in the late 1960s and 1970s, the largely progressivist (as I have argued in Chapter Six) "Logo philosophy" for education appealed significantly to the radicalism of those "progressive" teachers on both sides of the Atlantic upon Logo's introduction into the US and British mainstream schools (and the parallel publication of *Mindstorms*) in 1980. The following quotations from the research data indicate that to such "progressive" teachers Logo was more confirmation than revelation; it was not a new movement itself but, rather, an expression of already existing ideas connected to their social and political radicalism. Molly Watt, a former maths teacher (today a curriculum developer at EDC, Newton, Mass.)[75] remembers:

> I have been in other movements... I didn't see it as more special than what was happening in the "whole language" and other things that I had been part of before. What was happening in Logo seemed every bit as important and significant to me... So we saw Logo as one more of a very powerful handful of important endeavours happening in our lifetime and we threw our energy into it... The ideas weren't radical to me, I was already in those ideas. (23)

Along the same lines, another secondary maths teacher in England at that time- says:

> I already shared the educational ideas underpinning *Mindstorms*, [it] didn't change the way I thought about education... It gave me a sense that there was a possibility to operationalise in education the ideas that I already agreed with... So what I found in *Mindstorms* was not a new educational philosophy; I found a way of putting into effect the educational philosophy I already believed in. We are talking about 1980, the height of the progressive movement (16).

The child-centred, Piagetian-like constructivist approach of the "Logo text" resonated with the ideology of "progressive" teachers who were dissatisfied with traditional school. A small community of radical teachers started developing for whom Logo became a kind of symbol, a metaphor for using the computer to break out of the traditional ways of doing things in schools:

> Papert's book *Mindstorms* (1980) was a breath of fresh air for those teachers who wanted to realise for their pupils all the promised benefits of the computer, but who rebelled at the simplistic "drill and practice" programs through which nirvana was supposed to be attained. The child-centred Piagetian pedagogy which seemed to be at the root of Papert's arguments chimed well with the way in which they had been educated as teachers, and with a still prevalent liberal-humanitarian concern for the personal development of the individual child. There was no expectation that here was a device for "jacking up" children's scores on conventional attainment criteria. At its peak, Logo combined a support environment not dissimilar to a charismatic religious movement, with a rationale which offered teachers a chance of actually putting child-centred approaches to learning into action (Cooley, 1992:59).

In the context of disillusionment from the existing educational system, Logo was thought by those teachers as providing -at the level of pedagogy- a liberating solution to the authoritarian conservatism of traditional classroom maths instruction:

Papert's ideas in *Mindstorms* resonated with the philosophical stance of educators who believed in child-centred environments. For those who translated this approach to mean child-directed activities within the environment, Logo offered them a new opportunity to provide rich (especially mathematical) experiences. The mathematics reforms of the 1950s and 1960s introduced into schools in the 1970s fell short of the mark. Thus in many open-education classrooms Logo became another chance. For some mathematics educators (Leron, 1985; Hoyles, 1985), Logo offered a new way to teach the mathematics they have had limited success in teaching before (Solomon, 1986:131).

Considering also that from its initial development Logo had been offered explicitly as an alternative conceptual framework for the teaching of mathematics, the isolation of Logo developers from the mainstream (and largely conservative) mathematics education community, and their rhetoric of bypassing rather than reforming the existing math education, appealed particularly to some mathematics teachers who were dissatisfied with the way of thinking which had earlier given rise to the "New Mathematics". In this context, the introduction of Logo in schools in 1980 was viewed by those "progressive" mathematics teachers as an opportunity for a radical departure from the dominant culture of mathematics education at the time. Dave Pratt and Celia Hoyles recall:

Rather earlier than the 1980s there was the Modern Maths movement which had started in the 1970s so we were sort of coming through that in a way... But in practice the vast majority of the teaching was that sort of conventional traditional stereotypical type of teaching (19).

The fashion in Mathematics Education was the New Maths. It was all about global structures and set theory and stuff like that (11).

Meanwhile, at the level of producers, the contemporary introduction of microcomputers into schools excited the MIT Logo Group which now thought it was closer to seeing their vision put into action. To some extent -especially in the United States- Logo became subsumed in the effort to appropriate microcomputers into educational settings. As a programming language it was thought of as capable of bringing difficult ideas within the reach of young children. Within this context of excitement created by the computer-literacy campaign, the rhetoric of *Mindstorms* contributed to a quick initial "success" of Logo. In addition to the affinity of Logo's educational discourse with the radical progressivism of some teachers, Logo carried the exotic aura of high technology. At a time of general euphoria for educational computing, so many other computer applications were very mundane and uninspired that Logo featured as more attractive. While computers were rapidly being acquired by schools (but without good software or clear notions for defining their role and use) the availability of Logo filled an obvious need in the educational community: it offered a seemingly "powerful" way of using the machines, it offered a vehicle to the desire for broad-ranging and highly desirable learning outcomes while being -at the same time- accompanied by respect for the child's "natural" capacities and initiative. Papert's futuristic vision of children using and controlling computers resonated strongly with the excitement for the use and appropriation of computers created by the "computer literacy" campaign. Coupled with the desire to introduce computers to schools (largely driven by the computer industry as I have demonstrated in chapters Three and Seven and in Appendix One), the eloquence of *Mindstorms* contributed to the excitement of some teachers who viewed Logo as their new opportunity for progressive educational reform. John Berlow, editor of *Mindstorms* who worked closely with Papert, recalls:

> I think mainly what happened was that -because of Seymour's kind of breadth of interest and perspective- a lot of teachers... took it up as a new kind of way into progressive educational reform...The influence of progressive education was still alive. Logo was seen as a way to give some kind of backbone to progressive education (3).

Finally, considering that the majority of people at the MIT Lab were activists coming out of the social movements of the late 1960s and 1970s (as the discussion of the MIT's culture of production in Chapter Five has illustrated), we can see more clearly that -at the producers' end- Logo was a symbol of radicalism. It was considered to be the cleanest example of an anti-school use of the computer, of a use of the computer very different from anything that was happening in the school; as Berlow recalls, Logo became the metaphor for the most subversive use of the computer:

A lot of people around Seymour -including myself- were people who were always attracted to the various movements in turn, from marxism and leninism to psychoanalysis and artificial intelligence. So I think the kind of energy and hope for some kind of radical transformation of society was embodied in the energy around Logo. It wasn't simply to make an incremental difference, it was to radically transform and to show that the current situation was essentially hopeless (3).

In this sense, at the point of its introduction into mainstream education, the baton of radicalism was handed over from producers to the few "progressive" teachers who would use Logo in their classrooms. At a historical moment in its lineage, the radical messages of the "*Logo text*" (or -perhaps more correctly- those radical messages of the "Logo text" which had survived the compromises at the level of production) were shared with the few radical teachers who set out (some of them with the zeal of missionaries) to concretise elements of the vision in their classrooms. Within this "Logo community", which apart from producers now included some excited "progressive" practitioners, "Logo", at the end of the 1970s and at the beginning of the 1980s, took the proportions of a political project and a culture, as it becomes obvious in the following words of Resnick:

The Logo community has multiple dimensions... (it) has new ways of thinking about learning, new ways of restructuring education, new ways of changing relationships between children and others in the world. For the people who are deeply involved in the community Logo is not just a piece of software but it's a theory of learning, it's a philosophy, it's a strategy for education, it's all those things brought together... That's an important part of why the people who have been most involved in what has come to be known as the "Logo community" feel this sense of community (20).

As I will illustrate in Chapter Nine, some of those "progressive" teachers would try to use Logo in their classrooms in radical ways to breakdown the barriers between subjects, in a movement away from collection to integrated codes (discussed in

Chapter Six). For those "progressive" teachers Logo became a means for the expression of an appropriate curriculum politics for the left which was offered as the articulation of a *counterhegemonic* discourse linked to a broad-based political movement for change (Laclau & Mouffe, 1985).

4. Linking *context* to *consumption* (moments 4 and 5): the Lamplighter project.

The Lamplighter project (1979-1982) provides a concrete example of a radical appropriation of Logo which became possible within the conducive "progressive" environment of a single school at the end of the 1970s and the beginning of 1980s; an appropriation of the "Logo text" which was largely in-line with the preferred messages encoded in *Mindstorms.* It was an ambitious project carried out at the *Lamplighter School* (a private school) in Dallas involving students aged 3 to 9. Conducted as a joint effort with the school, the MIT Logo Group and *Texas Instruments* (*TI*), the project was intended to provide the school with enough computer hardware that access to computers would not be a limitation on what the students could learn. Logo would be taught to all students and teachers, from nursery through grade four. Eventually, the project was expected to enhance learning in many areas as it facilitated the use of the computer as a multipurpose learning tool throughout the curriculum (Watt, 1982:117).

While the Brookline Logo Project[76] was still running, Erik Jonsson -founder and President of *Texas Instruments* and ex-mayor of Dallas- offered to fund and equip a Logo experiment in the *Lamplighter School. Lamplighter* was near *TI*'s headquarters. Jonsson was Chairman of the *Lamplighter*'s board and a major benefactor of the school. *Logo Computer Systems Incorporated* (LCSI), a company set up by Papert and others to realise the commercial potential of Logo, created a version of Logo to fit the home computer then produced by *Texas Instruments* (TI-99/4). By spring 1979, the *Lamplighter* staff were trained and fifty computers were ready for the school.

The *Lamplighter School* offered the MIT Logo group a chance to test Logo in a child-centred, yet untypical, setting. *Lamplighter* was an exclusive private school with 400 pupils and a pupil-teacher ratio of 10 to 1. The child-centred philosophy of the school was close to Papert's philosophy for education. Children here were allowed to follow their own direction and learn in purpose-built open-plan learning areas with no walls between the classrooms. The following excerpt from a 1982 magazine article by Daniel Watt, a former school teacher involved in curriculum development and the Brookline Logo project at MIT (a member of the "reformers" strand of the MIT Logo Group), gives a sense of the flavour of the school and of the way in which computers and Logo were being used:

In the third grade, several children were clustered around two computers. One of them had made a "secret" animation program that made a number of sprites move continuously in a dynamically unfolding spiral. Three boys were trying to duplicate the procedure on the adjoining computer. Another child was designing a sprite shape for the center of the screen that would look as if it were emitting the spiralling sprites. Competition, co-operation, communication, problem solving, programming, geometry, and artistry were all happening at once. Meanwhile, the teacher who had introduced the basic idea that all the students were building on was helping another student figure out how to make a sprite move in a circle (Watt, 1982:132).

Lamplighter (its name was derived from Aleksandrov's saying: "A child is not a vessel to be filled but a lamp to be lighted") provided the Logo Group with an ideal environment and a child-computer ratio of 4 to 1. In this setting, the Logo experiment was seen as a success:

On a recent visit to the school, I was struck by just how comfortable the children are with the computers. Two 4-year-old girls were using a computer to construct geometric designs on a screen with square-shaped sprites... Nearby, classmates were engaged in more conventional activities: building with blocks, putting together a puzzle, playing with toy cars, playing house, and finger painting. Computers for these young students are just another way of exploring their world (Watt, 1982:132).

The Lamplighter project showed that an appropriation of the "Logo text" near to that envisaged by Papert was possible within conducive local environments which value alternative approaches to teaching and learning. The project is an interesting case-study illustrating clearly the important role of the local institutional context of Logo's use in shaping the outcome. It shows the possibilities existing for a certain 'reading' to occur in such an environment which is more in-line with the original expectations and intentions of Logo's designers. This example of a "success story" which mobilised Logo as a vehicle for educational change shows that it is likely that within specific locations providing a fertile context radical ideas can be successfully utilised.

However, such isolated success stories have remained a sad minority in the lifeline of Logo (an argument which I am going to support with evidence in Chapter Nine); the possibilities for such a radical utilisation of Logo in classrooms were never allowed to develop significantly in mainstream schools, partly justifying Papert's thinking that no school as we know it would be able to deliver his vision. I can propose at least three possible answers to the question why the radical appropriation of Logo has remained a distant vision. First, we should remember that part of the radical vision of Papert had already been lost in terms of the dominant message of the "Logo text" through compromises in the moments of production and marketing. Second, evidence suggests that Logo -as conceived by Papert in *Mindstorms*- was fundamentally at odds with organisational and institutional features of the school context within which it was being introduced as it struggled "with the task of integrating new forms of learning into old structures" (Watt, 1982:134); this tension -which will be discussed in the following chapter- meant by definition that some kind of new settlement would have to be made if the two were going to co-exist. Based on evidence from interviews with Logo's developers and practitioners, as well as on data from classroom observation, I will demonstrate in Chapter Nine that the settlement reached -if any- was far from favourable for a radical appropriation of Logo; that in the context of the dominant institutional structures, it was only in very unusual school settings (like *Lamplighter*) that such radical appropriations of Logo could occur. Finally -and closely related to the previous explanation- I will demonstrate that the chances of schools as a whole activating the "latent" radical messages of the "Logo text" were very few in the 1980s given the shift in priorities under the conservative restoration. In other words, I will argue that, although a good part of Logo's counterhegemonic messages were still there, the changing social and political conditions surrounding schooling in the 1980s meant that the possibilities of activating the submerged messages became less likely and less feasible. The remainder of this chapter will outline a preview of these changing conditions.

5. Logo vs the conservative restoration. The progressivist perspective in both the US and British education was strongly answered in the late 1970s and 1980s with the "back to basics" movement in which tighter regulation of the curriculum and the teaching process were imposed and legitimated under the call of national security and interest[77]. As the US economy slipped within the global market place in the 1980s, questions concerning the quality of teachers and teacher education programmes further legitimated standardisation of the educational experience:

> The calls for the social reconstruction of the 1960s gave way to the needs of a middle class to hold on to what they already had. Education again had to answer the call of accountability, efficiency, and control for the purpose of a stronger economy and national interest on a global scale. The underlying interest was to maintain the status quo (Muffoletto, 1993:100).

From a US perspective, Shor (1986) situates this attack on education within an analysis of the period since the late 1960s in terms of a conservative restoration in US politics beginning with the watershed election of Richard Nixon in 1968. Thus, the fact that Logo was not widely available to US schools before the early 1980s meant that the changing political climate in US education made it virtually impossible that any generalisation of the vaguely progressive uses of Logo would occur. By the time Logo was introduced into US mainstream schools, the political climate of rebellion and reform that had marked the 1960s was no longer present: as the decade wore on, the rise of the new conservatism in educational policy reflected a pervasive retreat among progressive forces:

> Using the rhetoric of the civil rights movement's anti-elitism, educational conservatism took over in the mid-1970s leaving fervent ideologues of educational reform bewildered and ashamed. Administrators and teachers who had furiously tried to "retool" in the hectic sixties breathed a sigh of relief and set out to invent a new ideology of learning which stressed "standards (Aronowitz & Giroux, 1993:58).

In a more global manner, Ball (1994) also points to this restorationist impetus in education which he sees as continued into the 1990s:

> ...the project of educational restoration is clearly evident in education systems across the English-speaking world and is also part of a wider movement of regressive traditionalism within New Right political thinking (Ball, 1994:29).

Discussing the attack that the right in both Britain and the USA had launched on the work of schools and the practices of teaching and learning in educational institutions, Avis (1991) wrote from a British perspective:

> The concern with standards, both academic and attitudinal, is paramount. Schools, it is argued, have been lax, whilst child-centred curricula which work from children's interests are considered antithetical to a disciplined and serious engagement with knowledge. Thus there is a call for a return to basics. The attack from the right has keyed in with popular sentiments and paradoxically is supported and reinforced from the "left" (Avis, 1991:116).

The "attack" on progressivism was also reflected in the effort to centralise and standardise schooling. According to Gordon (1985) this was attempted

> ...largely through cuts, which eroded the basis of progressive education, with its dependence on diverse resources. With the simultaneous advent of monitoring teacher autonomy was narrowed... The flexibility and teacher control necessary in child-centred education were less and less possible (Gordon, 1985:121).

This effective counter-attack by the conservatives at the ideological level accounted for the reversals that have marked the 1980s and is largely responsible for what the literature -in a journalistic rather than analytic manner- calls "the pendulum swing" against Logo. Within this adverse political climate of the 1980s which generally devalued and discouraged radical approaches to pedagogy, there has been an increasingly more pervasive backlash against Logo -especially evident in the US- where Logo has been in a sense denounced as "having failed to deliver what it promised". Today there are relatively few classrooms that use Logo, even fewer that use it "in the spirit" advocated in *Mindstorms*. There is an impression that Logo has run its course like a number of other educational innovations in the past (see Appendix Eight).

In the early chapters of this thesis (more clearly in Chapter Four), I have argued that an examination of the context within which a cultural product like Logo is brought into existence and operation is absolutely indispensable. In consistency with this theoretical position which considers the study of *context* as an integral part of Logo's circuit of production (moment 4), this chapter has situated the "Logo text" (and the possibilities that this seemed to offer) within the wider social and political conditions of its time. Having oultined, in broad strokes, the uncomfortable "cohabitation" of Logo with the conservative restoration of the 1980s, the question now arises of the place that Logo occupied within the institutional and organisational cultures of mainstream schools (and the power structures already in place) upon its introduction into them within this broader context.

CHAPTER NINE

Windows on the "Consumption" of Logo

1. Different Logo cultures. Logo was not simply received as a finished product from the context of production and implemented at schools; rather it was subject to interpretation within the context of "consumption", it was "re-created" and re-constructed -as is always the case with educational innovation:

> Those who participate in a program at the school level will interpret it in their own terms, in relation to their own understanding, desires, values and purposes, and in relation to the means available to them and the ways of working they prefer. In short, all aspects of a program may be contested by those involved in a program, moreover, a program is formed and reformed throughout its life through a process of contestation (Rizvi & Kemmis, 1987:21).

Upon its introduction to mainstream schools, the various participants in the life of the school did not confront the "Logo text" as naive readers; coming to school with their own histories, with experience, with values and purposes, they had vested interests in the meaning of the text. Thus the "Logo text" assumed as many different interpretations as the different individual histories, experiences, values and interests making up any classroom arena. In 1985, Seymour Papert was writing:

> There are tremendous differences in the ways that Logo is being used by different people - even in their perceptions of what Logo is or not...when I travel across the country and the world seeing Logo in many different contexts and many different classrooms, I am struck by the variety of forms it takes in these different settings with different teachers and different children (Papert, 1985:3).

Beyond the encoding of certain "preferred meanings" in their artefact and its accompanying philosophy, the developers of Logo could only partly -if at all- control the meanings attached to their "textual package" at the level of "consumption". Parts of this "text" were rejected, selected out, ignored, misunderstood, etc. The interpretation and appropriation of Logo was and is a matter of struggle. Similarly to the case of policy texts (Ball,1987,1994; Rizvi & Kemmis,1987), different interpretations of Logo were and are in contest, as they relate to different interests, one or other interpretation will predominate, although deviant or minority "readings" may be important.

Upon Logo's introduction into mainstream schools, the great majority of teachers faced the dilemma of deciding whether to adopt all, part, or none of the changes implied by the innovation and the cost of implementing these changes in their classrooms. In making such choices, teachers had to determine how much value to attach to what they already did, how much changes would help their students, and how much energy and time they could invest to make the changes, given the organisational and personal constraints that they faced daily. Logo as an educational innovation was utilised in very different ways in different school and classroom contexts with very different results.

My observation of school classrooms using Logo in winter 1994 and spring 1995 has provided contrasting pictures of distinctly different appropriations of "Logo". An interrogation of my fieldnotes and interviews with teachers provides evidence of variable appropriation of Logo in different classroom environments permeated by different values, commitments and priorities. For example, my fieldnotes from *Bridgwater Primary*[78] (a white middle-class school in Warwickshire with a "progressive" tradition), reveal that Logo here was appropriated as a "cultural building material", as a tool for the growth of a classroom culture which fosters exploration, co-operation and genuine learning. Talking about her current as well as her previous Logo work with a group of 7-year-olds, one of the teachers says:

What I find most attractive to learning with Logo is that it is learning-by-doing, which is the essence of progressive education (27).

By contrast, my notes from a Year 7 classroom at *Willow Park School* (an inner-London girls only multicultural-multiethnic secondary school)[79] reveal a strikingly different mode of Logo "consumption" whereby pupils met Logo in a computer room, where each sat down in front of a machine trying to draw -in a planned and orderly sequence- shapes "putting into practice" (I quote the teacher) what the school system's educational objectives describe as "Logo": trivial introductory turtle graphics commands[80].

What is common in these two Logo experiences? Both involve Logo, both involve the use of computers. However, the two educational enterprises have different goals and have used Logo for quite different purposes. What is most important to each is not shared: they use Logo not to become more alike, but rather to develop their individuality. In the end, each becomes more purely itself and so more distinctly different from the other. The examples of these extremely different "readings" of Logo indicate that the fact that Logo is available in a classroom does not automatically mean that it will be used at all, or that it will be used in a particular way and style. Furthermore, they indicate that the "consumption" of Logo in and of itself does not guarantee major changes in either the goals, processes, or outcomes of education.

Upon its introduction into mainstream schools, "Logo" was interpreted, re-constructed and appropriated in a variety of ways spanning the whole range between the two extreme approaches that I mentioned here, including various hybrid mixtures of child- and teacher-centredness. However, as evidence provided later in this chapter suggests, in the great majority of classrooms in which it has been used (both in the US and the UK) Logo was taken up as part of a conservative educational practice, as part of an incremental viewpoint of educational change which was very different from the expectations its designers had for radical reform. Discussion of other moments of the Logo circuit has shown that a conservative "reading" of Logo as turtle graphics was quickly established as a dominant "reading". This chapter will demonstrate that -- added to an already existing conservative institutional structure which has tended to deradicalise the take-up of Logo-- the changing external environment discussed in Chapter Eight (the conservative restoration) made it much more likely that the conservative "readings" of Logo would predominate. This will be done mainly through the discussion of how Logo interacted with certain organisational and institutional features of traditional schooling within the context of the conservative restoration in the 1980s.

2. An uncomfortable "cohabitation". With the exception of a few "success stories", the introduction of Logo into mainstream schools in 1980 was the beginning of a big deviation that went away from Papert's original intentions of "educational megachange" (bypassing school) to the direction of evolution rather than revolution:

> It started a route that made it [Logo] a school thing whereas originally in my head it was an anti-school thing, it was **instead** of school (18).

Thus, since 1980 we witness a contradictory and rather problematic effort to capture and contain this somewhat utopian and romantic conception of *education* within the institution of *schooling*. Thirteen years after the publication of *Mindstorms* and the introduction of Logo into mainstream schools, Noss (1993b) judged that the opposite of Logo developers' vision of educational change was taking place, a judgment which applies to today's situation with equal force:

Far from withering away, schools are called upon to play a greater and greater part in the education of young people. Far from being used as an instrument of intellectual liberation, computers are used -both inside and outside school- as a mechanism to increase the degree of social control exercised over children. And almost everywhere, Logo has become -in its school instantiation- a shadow of itself, a means to draw pictures, learn about angles, develop "problem solving skills" (Noss, 1993b:2).

The introduction of Logo into mainstream schools was one of many instances of attempted fundamental change in the school and classroom since the turn of this century that were adopted in many classrooms and yet, over time, either were marginalised into incremental ones or slipped away, leaving few traces of their presence. How and why did this occur? How did teachers react to the introduction of Logo in mainstream schools and how did they tend to use it in their work? What did "Logo" come to mean to them at the level of practice? Were the meanings they made of Logo different from the dominant messages "encoded" in the artefact by its producers? If so, why and with what consequences? These are some of the questions asked in this chapter.

A long history of research on change in educational settings suggests the importance of an awareness of the ways in which the structural and organisational aspects of educational systems interact with the adoption and adaptation of innovations (e.g. Sarason, 1971; Cuban, 1986; Fullan, 1991; Hodas, 1993; Ball, 1994). Therefore, an awareness of schools and classrooms as social organisations that both influence the ways in which an innovation will be adopted and are influenced by that innovation (in sometimes unanticipated ways) is necessary in any effort to answer questions like the ones listed above.

3. Logo, educational innovation, and the organisational culture of schools. As already discussed mainly in chapters Six and Eight, the "Logo philosophy" was a discourse of fundamental reform: its aim was to transform existing structures of schooling including classroom practices. The premise behind the Logo discourse was that basic structures were flawed at their core and needed a complete overhaul, not renovations. In this sense, Logo was an innovation which contained the promise of disruption of school routine and of the normative function of mainstream schools. However, sociological literature on educational innovation suggests that schools are, perhaps first and foremost, organisations seeking nothing so much as their own perpetuity:

> As organisations schools experience change or the challenge to change most significantly as a disruption, an intrusion, as a failure of organismic defences (Hodas, 1993:2).

Considering that school itself has been developing as an institution in the West since the Enlightenment largely based upon a number of institutional and organisational values like respect for hierarchy, competitive individualisation, a receptivity to being ranked and judged, and the division of knowledge into discrete units and categories susceptible to mastery, the introduction of Logo into mainstream schools (especially secondary schools where the division of knowledge into separate subjects is much more clear) was felt as undesirably disruptive as it meant that the culture should change its values and habits in order to implement it; the introduction of Logo was felt as a threat to traditional school structures. In this sense, Logo (which was, after all, a set of practices glued together by values) met serious "resistance"; as I will illustrate in the following sections, in most cases it was "neutralised" and incorporated into existing schemes of work by the conservative power structures already in place. At the level of "consumption", therefore, the appropriation of Logo as "another school thing" must be viewed as evidence of a resistance to the re-visioning of the values and purposes of schooling itself, a struggle over the soul of school. In the words of Celia Hoyles:

> An institution like school likes things as they are and will resist... When a foreign body comes along it wants to keep it out. Because it upsets the way the curriculum is organised, the way the hierarchy is organised... I suspect that there is not very much difference in terms of the reaction to Logo and the reaction to any innovation (12).

In this sense, it is still the case that the more radicalised adoption of Logo would have been resisted even without the conservative restoration. As this chapter is going to demonstrate, the difference under the conservative restoration was that it almost became a choice between a de-radicalised Logo or no Logo at all.

4. Inside classrooms: Logo and the disruption of classroom's traditional social organisation. As already said in chapters Six and Eight, a small number of "progressive" teachers who were familiar with the "Logo philosophy" for education tended to view Logo as another chance for radical educational reform. Molly Watt remembers:

> We became very excited by Logo and by what children were doing, it was the most interesting intellectual experience in our lives. We were very excited...becoming a community of learners **with** the kids; it changed our relationship, we were no longer the experts. We were all learning together and it was a different kind of educational experience (23).

Teachers in this category tended to use Logo very much in the ways anticipated by its originators, in what were thought to be creative ways which were transforming the way students were learning and ways that were opening up new types of ideas to both students and teachers. Logo became their way to restructure what education should be about. They viewed Logo as a way to change existing educational arrangements towards a direction of child-centredness, exploratory learning and open-ended projects. As already mentioned in Chapter Six, Logo work was used to cut across the division of the day into periods, the division of knowledge into subjects, to break off the ordinary structure of the curriculum and the traditional power relations in the classroom. Brian Harvey, who at that time was director of the computer centre at Lincoln-Sudbury Regional High School in Massachusetts, remembers:

> Kids set up their own working partnerships; more experienced kids taught newcomers. *Most of my effort went into this meta-curriculum rather than into teaching programming.* It didn't always go smoothly; there were fights, violations of privacy, and the like. But we all saw these problems as community problems, not just as something for me, the teacher, to deal with (10).

As Mitchel Resnick[81] recalls, in some classes the innovative enthusiasm of teachers went beyond the expectations of Logo's producers:

> In some classrooms there were phenomenal things that happened. Some teachers used it in ways that Steve and Seymour and I had never imagined. They pushed in directions that we hadn't imagined and some of the things that we had dreamed about did come about... (20).

Beyond those relatively few committed teachers, however, the reaction of teachers was not a single, universal sort of reaction and the ways in which Logo was taken up were incredibly uneven. There has been a variety of responses depending significantly on the views and visions of teachers using it as well as on the culture of the school in which Logo was being introduced; the different modes of Logo "consumption" reflected different ideologies over the nature of school and its curriculum. There have been at least another three types of teacher-responses to Logo. First, a number of teachers did not see the point of the particular kinds of semantics and the perspective that the "Logo text" had as compared with other teaching approaches. In many cases these teachers were looking at Logo as just another computer program and were comparing it with the sort of computer games and trivial CAI programs that were available in the early 1980s. Very often they regarded such computer games and puzzles as more motivating and superior to Logo because they provided immediate feedback to children. Other teachers did not see the "revolutionary" promise that had excited their Logo-enthusiastic colleagues but, instead, they tended to see Logo as a reasonable way to use the newly acquired computer equipment, as a way to "computer literacy". Subscribing mostly to what I called in Chapter Three a "social rationale" for computers in education, teachers in this category tended to use Logo as a means of increasing children's familiarity with the new technical medium. In other cases, some teachers' personal self-image conflicted with Logo as an innovation; for example, in defining themselves as non-technology persons or -most importantly- in finding themselves in disagreement with the progressivist "Logo philosophy".

Evidence suggests that for many teachers Logo -far from being an exciting tool for the re-consideration of their views and practices- represented a threat to the stability stemming from the familiar patterns of work. The child-centred principles of Logo challenged their self-image as professionals, by threatening to take away the primary commodity of superior knowledge, skills and expertise upon which they all, to a greater or lesser extent, relied to gain power and maintain control in their classrooms. To work with Logo in the way its ("reformers"-let alone the "revolutionary") designers had envisaged meant that teachers should make a fundamental shift in their relationship with pupils so that they became co-learners, engaged in a joint exploration of how Logo could be used and negotiating each difficulty as it arose in collaboration with their pupils. This, however, was a lesson not learnt for many teachers who had a technical-rational view of themselves as professionals which was making Logo difficult and traumatic as an innovation. Although "reflective practice" was the dominant orthodoxy in teacher education and professional discourse in the 1980s, in the reality of day-to-day practice of many teachers the view of themselves as reflective practitioners which Logo implied automatically constituted a disruption of the classroom's traditional social organisation. Many teachers were not prepared to give up their role as authorities which was until then one of the fundamental parts constituting their definition as "teachers". This, for example, seems to have been the case with a group of teachers from Boston who spent a summer making a sequential "Logo curriculum" which they implemented in autumn. Dan and Molly Watt, who were their Logo trainers, remember:

After a week at school they were still delighted with it. But by the end of three weeks they threw up their hands in horror because Logo is a language and the kids talked to each other and they couldn't withhold commands, kids could try English language commands, they could talk to each other and learn commands. And all of a sudden the teachers had lost all control of the curriculum and the kids were doing things that took them very far beyond what the teachers had ever envisioned... The teachers thought that they could control the information and never get in over their heads. But the teachers went immediately in over their heads with all kinds of interesting bugs to work on. They couldn't teach in the same way, so it really changed their understanding of what the curriculum could be and what learning could be. *It's my guess that it maybe one of the reasons Logo was so difficult for some people to teach or to teach with, you should be prepared to give up control...* (23).

Other teachers had a concept of teaching which valued expertise and did not value experimentation and risk-taking, accompanied by a belief that the teacher, not the children, is responsible for learning taking place. These teachers were usually the ones who felt they needed to be in control of everything that was happening in the classroom. Ainley argues that it was those teachers who found it most difficult to see any value at all in Logo:

I am sure that if you could look at all the teachers who get enthusiastic, the one thing that they have in common is that they are teachers who are prepared to let go all of their control of what's happening in the classroom. They are the teachers who are prepared to let children experiment and explore and to be independent... And I am sure that it's teachers who have that philosophy in their classrooms who were able to get enthusiastic by Logo. And the Logo philosophy appealed very much to these teachers (2).

As I have discussed in Chapter Six, teaching with Logo most often requires handing over a high degree of autonomy to pupils who work on their own projects at their own pace. This means that a shift is required from a whole class format. This shift is likely to mean not only that different students work on different tasks, but that the classroom looks and sounds very different than it used to. Students are more likely to move around the classroom and talk with each other about how they do things. The teacher's role as lecturer becomes much less important, and his/her ability to juggle the competing needs of students working on different tasks becomes crucial. The teacher's role changes from that of the expert who presents information to be assimilated by students to that of a coach or tutor who assists students when they encounter difficulties in their relatively independent work. This shift means not only that the students receive more individualised help, but also that they, generally speaking, work more actively on their own rather than having the pace and content of their work controlled quite minutely by the teacher, as the following quotations from two different interviews with former teachers reveal:

Generally children loved it [Logo]; again, it comes to the issue of control and ownership. They felt that the work was theirs and they were doing projects that they wanted to do. And so it was meaningful for them (9).

They [the pupils] told a visitor at the end of last year that they liked Logo because they were the teacher. It's an issue of control, which is a huge area. How much control do children have in a normal classroom? Very little. Logo, at least the way I have been using it, gives them a considerable amount of control. That is one of its most fundamental virtues (29).

Children talking to me informally about their experience with Logo referred clearly to this issue of control and ownership; I quote from my fieldnotes:

What I like about Logo is the fact that you can build what you want (Julie, Year 2).

I like it when you can get to the part where you can just get on with what you want to make... (David, Year 4)

Many teachers, less motivated than the teacher above or less willing to experiment with classroom practices that they were unfamiliar and initially uncomfortable with, never made the transition from whole class didactic instruction to more collaborative, learner-centred formats. Another teacher confessed:

The children pick you up like a reference book, and when they have finished with you they put you down again. That's pretty hard for a teacher to take... (29).

Many teachers dreaded the occasions when they were "shown up" by their students, when they should voluntarily cede authority to the student who knows better how to "debug" the program or how to print effectively what he/she has created on the screen. This is the time when

... the brittle consensual veneer of adult expertise is cracked, the order of things briefly disrupted (confirmed by the sudden eruption of murmuring in the classroom), and casual but alert attention directed by teacher and students alike toward the performance of the evanescent student expert (Hodas, 1993:14).

A teacher who used Logo for a variety of purposes with her Year 3 students feels that this fear of looking incompetent or foolish was a major deterrent to others:

One of the basic rules I used to tell my colleagues is, 'Don't panic'. I am joking slightly, but I honestly cannot think of anything which sums it up better. The children will show you what to do if you get stuck. They often end up knowing more than you do... I remember a class developed some pretty sophisticated non-graphic procedures. They made up a conversation procedure for me to use which asked me questions and, depending on the answer, then asked more questions. They wrote quizzes and ended up well away from graphics. They certainly got well ahead of me (29).

In spite of the fact that a few teachers appeared to tolerate knowing less than their students without too much discomfort, many were quite wary of putting themselves in such a situation whereby they would have to reverse the usual situation in which they were more in command of the knowledge needed to perform well than were their students:

I had a booklet that Amanda [a colleague] had written explaining the function keys, but I just took Big Trak home and played with it a couple of times in order to keep ahead of the children (29).

Or elsewhere in the same interview:

I've tried to keep one step ahead of them by taking it home to prepare, and it's been well worth the effort (29).

The teachers' concern about being or appearing to be less knowledgeable than their students is understandable. The social structure of the classroom has traditionally been built around two complementary roles -that of the teacher and student. An important part of the teacher's role is the exercise of authority, that is, legitimated power over the student. The teacher's authority has a number of bases, but one of these is unquestionably his or her expertise. Although teachers have authority by virtue of the role they occupy, they must work to express and maintain that authority in order that it not be eroded. Any change in the classroom that seriously undermines the teacher's image as a knowledgeable and competent individual has implications not only for the teacher's personal feelings of comfort and self-esteem, but also for important aspects of classroom functioning related to the teacher's authority. Many teachers felt that to display a lack of expertise would give students an opening to ridicule them that the students would be quick to take -especially at a high school.

Although teachers most often mentioned a fear of looking incompetent, uninformed, or foolish in front of their students, it was not uncommon for them to experience the same feelings when trying to improve their Logo skills in both formal and informal training contexts in which students were not present. In fact, the fear of being embarrassed is reported as being a major de-motivating factor even at the early stage of training for the acquisition of the skills required in order to use Logo in the classroom. Dan and Molly Watt remember:

> Our approach was to say: "well, frustration is part of learning, debugging... learning to get help from other people". But some people were not so comfortable with that. And in every group of teachers who would come to learn this [Logo] there were some people who were very-very uncomfortable about having difficulty, about being publicly frustrated (23).

However, what my interview data from UK schools as well as data from interviews with teacher Logo-trainers in the US suggest, is that this anxiety of teachers is not a personal handicap or a professional ill which teachers should be blamed for. Rather, it derives mainly from the character of school as a rigid bureaucratic, hierarchical institution which concretises a particular tradition of pedagogy teaching as canonical a particular arrangement of paths for the flow of knowledge and information (that is from the teacher to the student):

> The other side [of the enthusiastic teachers] was some people found it very frustrating, because they expected to come [to the summer Logo courses] and receive a formula, so that they could then take something back and do what they had been told. So people got frustrated in a few ways (23).

5. In defence of teachers. Faulting teachers for refusing to change places reformers in the unenviable position of seeing teachers as both the problem and the solution. Such bashing assumes that most teachers are free to adopt changes, if they merely choose to; it assumes that when they do not do so, it is because they are stubborn or fearful of classroom consequences. Attributing to teachers the personal power to halt or divert change is a common tendency of those who locate explanations for events in individual action rather than assessing the potent influence of the situational contexts or a blend of many influences (Cuban, 1993). The analysis of the "consumption" of Logo in terms of the challenge it posed to the professional identity of teachers should not be taken as an attack on teachers or as an attempt to move away from a critical discussion of other (structural) conditions[82]. To hold individual teachers accountable for the "backlash" against Logo is like blaming the victim. Because teachers are only one part, one accessory in the mechanism of schooling and their "consumption" of Logo -whether it be excitement, resistance or anything between the two- should be viewed against the social-political and institutional context within which the introduction of Logo in mainstream schools took place:

> Proposals for change may ignore the dynamics of the social situation into which an innovation is "inserted"; not just the situation and the relations between situation and innovation but also the innovation itself inevitably change in unpredictable, irrational ways. Even if teachers and administrators were completely rational actors in attempting to implement a change (and of course they are not), they would not have the power to determine how the change worked out in practice. They do not have that much control over the social context in which they work (Kilpatrick & Davis, 1993:211).

Discussion of moment 4 of Logo's circuit in Chapter Eight has argued that this set of background conditions was characterised, in both the US and the UK, by conservative restorational politics and the educational policies attached to them. It is in this context of transition from an era of possibilities for "progressive" education which allowed schools and teachers a degree of autonomy to an era of control and accountability that the "consumption" of Logo in real classrooms should be situated. Research evidence suggests that the changing social and political context (conservative restoration) exacerbated the difficulties, but the "progressive" use of Logo would have been hard to sustain even before that.

6. Linking moments 4 and 5: consuming Logo in the conservative restoration.

The introduction of Logo in US schools has not had the character of an organised educational reform; rather, it was a grass-roots innovation initiated by a small number of Logo-enthusiastic teachers. Thus, in the early 1980s, classroomed-Logo was in its infancy and almost exclusively in the classrooms of Logophile teachers most of whom employed it in a "progressive" spirit, cutting across school's practices of balkanised curriculum and impersonal rote learning. However, soon after the publication of *Mindstorms* (1980) at a high time for the "computer literacy" campaign in the US, Logo was significantly connected to that rhetoric. Dan and Molly Watt remember that the US National Council of Teachers of Mathematics (which effectively made the policy for Mathematics, see NCTM, 1989) was a catalyst in this process:

They [NCTM] said 'children should use computers'... there were like ten points in a very short little document... It's what made schools feel they needed to have computers for mathematics...When Apples came out in 1980 **and** the NCTM agenda, suddenly people thought they should be doing something but they didn't have the slightest idea what to do. So they got Logo -that took care of Maths- and they got the *Bank Street Writer* which came out in 1983 and then they thought they had everything they needed for their schools (23).

As a result of its official association with the "computer literacy" campaign Logo was hastily introduced into US mainstream education at an introductory level only, with neither enough preparation of the teachers who were going to use it, nor an "appropriate culture" developed or an adequate infrastructure to sustain it as an innovation. This quick-and-shallow adoption of Logo soon became a boomerang against the original intentions of its producers as for the great majority of teachers (who had not been in contact with the language and its philosophy before) Logo became simply a playful way to give the children the opportunity to control the computers. Dan Watt and Paul Goldenberg recall:

...because Logo was adopted so quickly -because of the goal of computer literacy and because of Seymour Papert's own advocacy and forceful promotion of it- the quick success of it made it impossible that 'Mathland' would ever occur. Because it got adopted too shallowly by too many people too quickly[83] (8).

Partly due to the personal influence of members of the Logo group, some of the local school districts in the Boston area initially (Boston, Lexington and Brookline) and later throughout the country decided that Logo should be part of their curriculum, yet without any explicit educational rationale:

All of a sudden Logo became something to add to the curriculum but nobody really knew why. It was not used primarily for mathematics, it was not used primarily for... it was about "learning Logo"! (8).

"Learning Logo" was largely an end in itself within the context of the "computer literacy" campaign, used as a legitimation lending schools superficial glamour. Logo became an accessory to a technocentric way of thinking about education[84]. Within this context, teachers in the US were required to "teach" Logo as a subject at a certain age or grade level and all students were required to learn it going through a series of activities. In 1984 and 1985 these kind of curricula were in place in many schools throughout the country and some of them still are. Very quickly Logo became *institutionalised* and teachers were expected to teach it as any other curriculum subject, as just another "thing" that students should learn. A special curriculum for Logo was developed and in most cases specialist teachers undertook to teach it as Goldenberg and Watt remember:

> So what happened was you would have a curriculum and if you were a grade 4 teacher you would get a package just like you would get for mathematics, or reading or whatever your students were expected to learn, and some activities. And once or twice a week you would take your class to a computer lab and go through the activities with them (8).

This view of Logo as a "school thing" was a perversion of anything that the "revolutionary" strand of the original developers of Logo had imagined. The fact that Logo quickly came to be seen as part of the curriculum meant that any potential of Logo as a radical educational innovation had been neutralised from its early steps. Sherry Turkle remembers:

> Once it became part of the curriculum it was 'normalised' and some of the more radical ideas have gotten... somehow it became very hard to then say "look what's happening here, people are expressing themselves". Teachers would say "they are not expressing themselves, they are doing the Logo curriculum" (22).

Logo as conceived by Papert encouraged child-centred, experimental and unstructured activity; therefore it was going the opposite direction from the dominant ideology of a formal, common, specified and compartmentalised curriculum which schools were more and more intensively ordered to follow through the "Back to Basics" campaign of the 1980s. A primary teacher in England recalls:

I must admit that I was very wary at first about introducing Logo because I felt it was going to interrupt the children's basic skills lessons... (29).

From a UK perspective also, Bill Tagg, former director of the Microelectronics Education Advisory Unit in Hatfield (1982-1991), says:

Things have changed since because primary schools, too, have a much more urgent curriculum to get through. That's one of the reasons why Logo hasn't survived. But at that stage [early 1980s] the big difference between primary and secondary schools was the fact that there was time and opportunity, freedom from constraint in primary schools. Primary schools in those times enjoyed a very high degree of freedom that they haven't achieved previously or since. Ten years previously they would be working towards the 11+ exams... ten years later they were (?) in the National Curriculum. But roundabout that time they enjoyed a tremendous amount of freedom (21).

Along the same lines, Celia Hoyles, former mathematics teacher and today professor of Mathematics Education, argues:

Logo doesn't fit with the curriculum as it stands. If you have a curriculum that's very fragmented there is no nice place for it to fit... In the UK at that time it was a much more flexible curriculum particularly at the primary school, and those teachers could do more about what they wanted. US rather similarly I understand, but I suspect in Germany and in France it was much more laid down what you do and much more fragmented, so it's actually quite hard to introduce this. *And then why it's more laid down, probably it's a symptom of something else more fundamental* (12, emphasis added).

The why is not hard to detect in the following words of a London's secondary teacher which echo the flavour of the Black Papers[85] which in the 1970s provided a conservative political critique of progressivism, cloaked in populist rhetoric of contrasting anarchy and realism; like then, "Logo" here is linked to the growth of anarchy, and a "realistic" approach to education is advocated, namely the National Curriculum:

Logo, yes, did encourage you to do what you wanted to do... It was the final bastion of those people who wanted to do what they wanted to do. You can't have a sensible educational system where everybody just does what they want to do.... Logo breeds anarchy... And no national government, whether you are left-wing, right-wing or whatever, can allow that to happen... they all wanted a National Curriculum (4).

Logo presented a challenge to the traditional fragmentation of knowledge into separate subjects. Subject subcultures are identifiable structures which are visibly expressed through classroom organisation and pedagogical styles; they carry with them assumptions about "worthwhile knowledge", "good students", "effective teaching", and "excellent results". As I have emphasised in Chapter Six, the introduction of Logo put at stake these traditional codes; in fact, it set off a range of culture clashes:

> To the extent that teachers identify strongly with the teaching styles associated with their traditional subject subcultures, they may be reluctant to adopt a technology which seems incompatible with those subcultures (Goodson & Mangan, 1995:623).

Teachers were understandably confused and constrained; a former teacher, says:

> And so I had that sort of tension in my mind about what does one do about the fact that we have a defined syllabus, so even if one values the approach that John [a progressivist colleague working with Logo] was using could one actually afford to have that situation not being able to guarantee what it was that the children would actually work on? (19).

Logo was more easily assimilated where it fitted with existing practice and caused no substantial changes in content or pedagogy. Some teachers felt they had to modify their use of Logo to ensure that it did not disrupt the established subject subculture. The words of another teacher reveal this pattern of co-option and marginalisation of Logo into her existing teacher-centred framework as a separate "activity" outside the mainstream teaching and learning process:

> The first year I let the children play with Big Trak quite a lot. *It was more of an activity available if they had finished their work*, to play with and see what they could do. Next year I directed the children far more in what they did. I didn't allow it as free play: it's been part of a specific learning situation. They looked on it as part of their work *with problems I set* (29, emphasis added).

7. Computer labs and Logo tests. Despite the existence of a number of visionary teachers, the administration-controlled "reading" of Logo quickly became dominant, serving more to bolster the status quo than to undermine it. This is, in fact, more true of the US rather the UK context as there was quite a strong ideology of "permeation" in the UK approach to "computer literacy" in the 1980s (especially in primary schools). This "reading" of Logo went hand-in-hand with the isolation of computer equipment in separate rooms, away from the mainstream of learning:

> ...the pattern changed sharply. The initiative and the power in the field of computers were moving from teachers to school administrations -most often at the city or even at the state level. When there were few computers in the school, the administration was content to leave them in the classrooms of teachers who showed greatest enthusiasm, and these were generally teachers who were excited about the computer as an instrument of change. But as the numbers grew and computers became something of a status symbol, the administration moved in. From an administrator's point of view, it made more sense to put the computers together in one room -misleadingly named 'computer lab' - under the control of a specialised computer teacher. Now all the children could come together and study computers for an hour a week. By an inexorable logic the next step was to introduce a curriculum for the computer. Thus, little by little the subversive features of the computer were eroded away: instead of cutting across and so challenging the very idea of subject boundaries, the computer now defined a new subject (Papert, 1993:39).

Shunting attempts at fundamental reform like Logo to the periphery of the "regular" school is an old strategy for neutralising their transformative potential:

> Thus, some basic changes get encapsulated, like a grain of sand in an oyster; they exist within the system but are often separated from mainstream programs (Cuban, 1993:6).

Logo was encapsulated in the oyster called "computer lab". Children were brought to a (generally) windowless room presided over by a man (usually the computer specialist of the school) with rarely any other function than administering the machines. There, they were left to work for 30 or 40 minutes on Logo activities that in most cases involved writing trivial turtle graphics programs; Logo was used in ways quite opposite to the intentions of its original developers, as normative and pedagogical technology of a conservative type. A former primary teacher remembers:

> At first we tried sending the third and fourth year children down in groups to use Logo in the computer room, but by the end of the first term we had decided against that. Logo was coming to be seen as something separate instead of forming part of the classroom activities... (29).

As Logo was more and more viewed as yet another curriculum component, Logo *examinations* were devised, which was anathema to its producers' vision for Logo as a tool for exploration and thinking. Papert remembers:

> While the typical teacher in 1980 had this computer work in her classroom and was using it to cut across the division of the day into periods, the division of knowledge into subjects, to break off the ordinary structure, now there was this shift! The computers were put in a special room away from the mainstream of the learning, there was a specialist teacher, there was a special curriculum even, and -most horrifying- across the river in Boston for the last ten years every elementary school child has to take **a test** in Logo! Like taking a riding test before you are allowed to ride a bike. First it is pass the riding test and then you may ride the bike. And then it turns out that there aren't any bicycles or there are too few bicycles. If you pass the riding test you can ride the bike for five minutes a week (18).

The intruder (Logo) was effectively brought back into line with school's ways. Logo in the classroom was undermining the division of knowledge into subjects; it was turned into a subject of its own. It undermined the idea of curriculum; it was made the topic of a curriculum of its own:

> Today, Logo geometry has acquired the character of a canonical curriculum topic. Workshops for teachers introduce them to standard figures that they can have their pupils draw. The Netherlands has a set curriculum in Logo, and in the United Kingdom, Logo geometry is a topic in the National Curriculum (Kilpatrick & Davis, 1993:208).

8. Standardisation. School's concern with standardisation under the pressure of "restructuring" was not compatible with the "Logo philosophy" either. Traditional schools are supposed to produce the same outputs year after year. For example, they are supposed to ensure that seventh graders will emerge at essentially the same age with essentially the same sets of skills and broad values this year as last If they do not, then important categories like "seventh grade" or even "common school" lose their meaning. Standardised or "teacher-proof" curricula, standardisation of facilities, of teacher certification requirements, etc., guarantee standardisation of "outcome". For Goldenberg, Logo did not fit well in this scenario of standardisation:

It [Logo] included the philosophy of progressive education which said that students should be able to pursue their own interests... And that the way to foster good growth was not to track everybody into the same... Whereas in this country [US] we have schools -and a psychology- that tended to be built on a Henry Ford model of interchangeable parts... We are constantly having discussions about curriculum in a classroom -especially in Mathematics- where the discussions are based on 'what if the student moves from this class to that class? Don't they have to be doing the same things so that the kid will then fit in?' Or "what if he moves from this town to that town? we should have the co-ordinated everybody-in-the same...' You know, that kind of thinking. Or 'we have five tenth-grade classes; they are all going to go to eleventh-grade. Well, that eleventh-grade teacher... how will that teacher be able to teach them all if they haven't all learnt the same things?' (8).

9. Examinations, testing and results. Very often the cloud of achievement tests pressured teachers into compromises in their use of Logo. "Improving test scores", "accountability" and "pursuing excellence" were the new catchphrases circulating among insiders in the late 1970s and early 1980s; the discussion of the NSF funding cuts in Chapter Five has already registered the preoccupation of the educational establishment with test-scores and its hostility to the Logo "progressive" approach. With the onset of severe budget cuts as early as 1975 (in the U.S.), for many teachers survival replaced talk about reform. The swift turn of events discouraged teacher initiatives, risk-taking, extra efforts, and innovation. A teacher says in devastation:

I know I will teach my children how to take the test, although I realise this is basically against what I believe in... I do not have the energy nor, at this point, the willingness to fight the system. I know the scores of my class will be compared with those of traditional classes. The comparison is itself fallacious. I know that. But most parents do not. Many administrators do not and the system does not (29).

Peter Butt, a senior teacher of Mathematics and Computer Science at a London's Boys Grammar school says:

I don't use Logo in my normal GCSE or A level teaching as such... If we were using a computer we would take twice as long to do whatever we wanted to do, the boys would fail their GCSEs, the school last year was 31st in the National League tables for academic excellence, if we drop below 32 we will not have any customers, I will be out of a job... Well, it comes down to it..! (4).

And elsewhere in the same interview Butt argues:

Yes, Logo has to do with progressive education. You can do what you want to do and the teachers became fascinated by Logo themselves and they tried to pass on that fascination to their pupils. I have always been restricted by the fact that this is an academic school and we have always had very good GCSE results. And after all this is what the parents pay for. We would like to educate them as well, obviously. But the bottom line is 'how many boys do you get to university'. We assume that all our pupils will go to university or some form of higher education. We are a Grammar school... we try to educate them but one has to... that's it... *there are the pressures of the exams!... What it comes down to it, the boys at this school have to pass their GCSE and A level exams* (4, emphasis added).

The managerial preoccupation with results reflects the current tendency in education that any problem-solving activity which doesn't lead to a successful conclusion is a waste of time and should be avoided. As a result teachers do not have the opportunity to allow children to experiment in this kind of way because they are worried about how much "useful" material they have to go through. From a British perspective, Ronnie Goldstein, project officer for the NCET (former mathematics teacher), argues:

The fact that Logo faded away in the late 1980s goes back to what I was saying about the National Curriculum. And in fact now people expect the outcomes of the learning that's going on to be much more explicit. And people don't think so much about what the activities are that the students are involved in so much, they think more about the learning that the children have to achieve at the end of the day. And I think it's very very difficult to work in the sort of creative way that we are talking about with Logo if those are your aims (9).

Along the same lines, but from a US perspective, Goldenberg says:

...our entire educational system is too worried about being 'useful'. Certainly the current political climate is going to put a great deal of pressure on anything that doesn't have a quick pay-off and just get rid of it! (8).

Under pressure from many quarters to improve their "productivity", to maximise some measurable output while containing their costs, educational institutions in the

1980s were increasingly being run as businesses, which is even more the case in the 1990s. From a US perspective Bromley writes:

> One could interpret the current push for national testing as an example of viewing schools in such terms: it is a "quality control" mechanism meant to standardise the output of the educational process (Bromley, 1995,chap. 2:12).

10. Assessment and accountability. Closely linked to the achievement of academic "excellence", the mechanisms of assessment and accountability discourage teachers from taking the risks which the use of Logo implies. Janet Ainley and Bill Tagg say:

> There certainly was a time when -in primary schools at least- teachers still felt that they had a lot of freedom to do what they wanted to do in their classrooms. And that sort of pressures we have now about assessment and accountability just didn't exist. And it's hard now to go back to what that was like... (2).
>
> But teaching is really all about taking risks, it's about putting children into the driving seat, and that's a risk-taking business. But you don't get paid and you don't get promoted on the basis of taking risks, you get promoted on the basis of keeping your nose clean and doing what you are told to do. So teachers don't have the same autonomy and as a result... (21).

11. Logo in the National Curriculum. The re-construction of Logo as turtle graphics in the first version of the National Curriculum for England and Wales in 1988 (see Noss, 1993) intensified the process of Logo's marginalisation and assimilation as harmless into dominant structures[86]:

> Logo has suffered the fate of incorporation into a canonical curriculum, a transformation in which what was to have been an instrument for exploration is ossified into an object of teaching (Hoyles & Noss, 1996:164).

Logo was this time officially "read" as something teachers had to do for three weeks and then move on to something else, which was exactly the case at the *Willow Park* school mentioned at the beginning of this chapter:

> But suddenly then there was a big sort of 'everybody has got to do Logo, it's in the National Curriculum' and there was a great sort of such a... people wanting courses on Logo and

wanting to know about Logo, and in some ways that felt exciting and it felt good that Logo was being recognised in the NC, but actually in other ways the effect this had was that *teachers would do Logo for three weeks because the NC said they 'd got to do it and then they probably drop Logo when they didn't have to do it any more*. And actually I heard teachers saying to me that they would do it for three weeks and that would be enough. So it actually in some ways it had the opposite effect from encouraging it to be really integrated into school (2).

The words of Dave Pratt illustrate the devastation of teachers in the new order and partly explain why most of them ended up assimilating Logo in their existing practice in a rather conservative way:

So if you are a teacher with all the standard problems that teachers have and you have got these issues about parents worrying about the progress of their children and you have a Head of Maths or a Head of the school who insists that you work in a systematic and organised way and they want evidence of children's progress at each stage and the assumption is that the kids do tests and exams and all these sort of things... With all of that stuff there you will only go on to take on board Logo to the extent that you can assimilate it into your current system.... What else could we have done? (19).

Within an adverse political climate reinforcing the inherent institutional conservatism of schools, Logo -in most cases- ended up appropriated in ways different from the expectations of its developers and from the "preferred meanings" encoded in *Mindstorms*. In most elementary classrooms it was used simply as a way to teach children how to draw squares and triangles; its use was trivialised and its radical potential neutralised. Feurzeig says:

What happened in elementary schools is that kids used the Logo turtle graphics to make flowers, houses and trees and so on. Just after that point things sort of stopped there for a number of reasons. In many cases its use is trivialised -that's not surprising (7).

The vast majority of the teachers who have used Logo have tended to use it as part of a conservative educational practice assimilating it into their existing schemata of work:

What people do is they try to put it into whatever system they have at the moment. So if there was something there that you had not seen before, you would evaluate it in terms of things that you currently understood (19).

At the level of pedagogy, Logo was a way of work which involved substantial laboratory-experimental kind of project-based work. In the early 1980s, the environment for such activity was no longer there as the priorities were shifting; mainstream schools -especially secondary- were no longer providing a felicitous environment for open-ended, creative experimental activity. Margaret Williams, a primary teacher currently using Logo, says :

> The boys have one hour a week ...you see the requirements are different nowadays, to teach the "basics" (25).

Could history have turned out differently? Although it has given us a glimpse of an alternative, the discussion of the Lamplighter experiment in Chapter Five, with its untypical institutional context, cannot be taken to provide an affirmative answer to this question as the project did not last enough in the 1980s to be tested under the changing conditions. In this sense, perhaps Bridgwater can be seen as a more realistic example of a "pocket" of continuing "resistance" after the conservative restoration. Such isolated success stories show that despite the depressing power of the context over the ways in which Logo is used there is still some space for a radical appropriation at conducive local environments which value alternative approaches to teaching and learning. Yet, in the current context, they seem likely to remain marginalised in the absence of a wider transformation of the structure and culture of contemporary schooling.

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CHAPTER TEN

Lessons from Logo

1. From productionism to cultural studies. A significant part of this thesis has been an attempt to foster certain ways of viewing technology and its role in social relations, with emphasis on education. Appropriating and developing a "circuit of cultural production" approach which was initially introduced by Johnson (1983), I have used the case-study of Logo in this project to illustrate the social, political and cultural nature of education and the significance of struggles over educational innovations which have at times challenged conventional thinking about schooling. Drawing on established social science concepts and theoretical perspectives I have suggested that sociologists of education and sociologists of technology may help by adopting a cultural studies perspective for the analysis of educational technology.

Given my frustration with technological determinist accounts of educational computing (registered mainly in Chapter Three), I have been at pains (in consistency with the theoretical position assumed in the early chapters of this thesis) to demonstrate empirically that technologies do not follow some predetermined and inevitable course of development; rather, they are socially shaped, locking into institutional arrangements and social forces, thus embodying elements of the prevailing social relations. Moreover, moving away from a physicalist definition of technology (a limitation of most approaches to the sociology of technology), I have argued that technology is deeply social and cultural and that technological products should be treated as cultural products.

In the past it was not unusual for sociological analyses of cultural products to begin and end with the processes of production; as I have argued in the early chapters of this thesis (especially in chapters Two and Four), the mode of production of a cultural product was often assumed to be the prime determinant of the meaning which that product would or could come to posses. Highlighting some of the limitations of existing approaches to the social shaping of technology in chapters Two and Three, I have discussed how social constructivist and political economist approaches to technology give undue prominence to the material production of technological commodities as if it were these conditions which dictate the meaning of the object in every other context. Breaking with this logic, I have argued in this thesis that, although such a model may seem appropriate in particular circumstances when applied to particular objects, it is not sufficient in itself as -with its tendency to undertheorise- it leads us to miss important aspects of the social shaping of technologies as cultural products. I have argued that the excessive focus on production and the economic (*productionism*) as well as on the internal workings of technologies are rather patronising positions to adopt as they have the effect of shutting down the analysis of culture. I have suggested that such a strongly "objectivised" view, with its neglect of any notion of human agency at other stages in the life of a cultural product (including the level of "consumption"), seems unlikely to be able to tell us very much about what people make or do with material cultural products such as Logo, once they leave the factories or the laboratories in which they are produced and imbued with particular (preferred) meanings. By contrast, I have suggested that discussing the development and evolution of technological products as cultural products from a cultural studies perspective is potentially more useful than most existing approaches to the sociology of technology and educational technology.

To illustrate the limitation of existing approaches empirically, this thesis analysed the biography of a cultural artefact (Logo) in terms of a theoretical model based on the articulation of a number of distinct processes whose interaction can and does lead to variable and contingent outcomes. Thus, rather than privileging one single "moment" -such as the processes of *production*- in explaining the meaning that an artefact comes to possess, I have argued in this project that it is in a combination of processes -in their articulation- that the beginnings of an explanation can be found. I have suggested that a *cultural circuit* approach derived from the field of cultural studies can enhance our social perspectives on both technology and education and discussed the case-study of Logo programming language as a cultural product in education. Such an analytical model is useful in that it enables us to find a way of holding all the various stages in the "life" of an object in a more balanced sequence so that we can consider the transformations effected on the object as it passes between them. I found in the "circuit of production" an answer to the problem of constructing a language in which that passage could be adequately represented.

The *circuit of production* which I have proposed here as a potentially useful analytical tool draws on Johnson's own circuit (1983, 1986). However, unlike Johnson who distinguishes between four "moments" (*production, text, readings* and *lived cultures*), the model I have elaborated is divided in five analytical stages: *production, text, marketing/economics, context* and *consumption*. Once again I wish to emphasise that, although artificially separated for the purpose of study and analysis, the various "moments" are closely interrelated and overlap: the case of the NSF funding-cuts to the MIT Logo Group (discussed mainly in Chapter Five) and the case of turtle graphics (the discussion of which cuts across "moments"), are examples of the close and complex articulation between the different "moments" of

Logo's cultural circuit. Although analysis has been divided in these five artificially distinct pieces, it has been made clear from the outset that these spheres are not discrete, causally related or sequentially ordered; rather, the model should be seen as a heuristic device. The cultural and political import of Logo is to be found in these multiple explorations taken together. And it is critical that they be, in fact, taken together. Although the "moments" have been separated in this thesis for greater discursive clarity, elements of all five are always present in any actual situation. They will have a presence in any real classroom, and their relative impact will depend on the specific circumstances. Given, however, the constraints mentioned in Chapter Four, analysis of moment 5 (*consumption*) in this thesis has provided only a first glimpse of what "consumption" of Logo in real classrooms may look like. A deeper *ethnographic* study of this "moment" in the circuit of Logo is needed which ought to go beyond the limits of this dissertation to capture -in a more systematic way- the more subtle and private aspects of meaning-making and the struggle over meaning in the use of Logo. According to Ball (1994:2), **ethnography** provides access to "situated" discourses and "specific tactics" and "precise and tenuous" power relations operating in local settings. Such a critical ethnographic study will provide the material for a more comprehensive account of what students and teachers actually ***do*** with Logo in their everyday life in classrooms as they are defined by the complex -and often contradictory- dynamics of social and cultural divisions. Such a study should concentrate its energies on exploring - through observing people "in action"- what individuals and groups make of and do while using Logo; it should attempt to analyse how Logo is made meaningful in the processes of its "consumption"[87].

To this end, the qualitative research of Sherry Turkle (1988) on the role of gender (as one among many variables) is a valuable example of an ethnographic description of what, in fact, often occurs during the "consumption" of IT in real classrooms. Turkle's work is important for the extended social shaping of technology model that I have proposed here, because it highlights the active role of the user in shaping and defining a technology's meaning[88]. Also, Schofield (1995) provides some examples of how the institutional and organisational context of schools interacts with the use of computers in education. Finally, the numerous studies carried out by Celia Hoyles and her colleagues of the Institute of Education provide an indispensable collection of material which would be a useful starting point for the ethnographer of Logo's "consumption".

2. The cultural circuit of Logo: some conclusions. A first general conclusion that we can derive from this analysis is that **Logo was a socially constructed technology**. At the level of production Logo did not evolve merely on its technical merits but, rather, it was the product of negotiation. The lack of agreement on standards, the tension within as well as between the groups involved, the range of approaches and objectives, unfolded as some of the clues supporting the argument that the development and evolution of Logo was not linear nor even primarily technical; rather, it was a "seamless web" in which the technical was interwoven with the social, economic and political. The development of Logo was shaped (in a continual evolutionary manner) by the concerns of the social players involved in its production. In line with the theoretical arguments developed in chapters Two, Three and Four, the analysis of Logo demonstrated that -in terms of their production- technologies (conceived in the broadest sense) develop as a function of a complex set of social, technical, economic and political factors: they are the expression of social and cultural interests in the course of struggle:

> Each technical artefact, piece of software, or curriculum innovation contains the crystallised traces of the negotiations, compromises and conflicts which brought them into being (Noss & Hoyles, 1996:181).

A second general conclusion deriving from the discussion of my case-study within the framework of the *circuit of production* (again in line with the theoretical arguments developed in the early chapters of this thesis) is that there is no such thing as a simple "fit" between producers' intentions and consumers' realities; that there is no such stable and easy correspondence between the production and "consumption" of a cultural artefact. I have demonstrated empirically through the Logo case-study that it is simply not possible to "read off" the meanings that a material cultural artefact like Logo comes to have from its processes of production, no matter how crucial those may be. To do so would be to impose

> ...an artificial closure to the biography of the artefact. For one thing, it fails to tell us how that artefact is used in social relations and what significance it obtains as a consequence of this usage (duGay et.al., 1997:84).

In order to support this argument with empirical evidence, I have illustrated in chapters Five and Six that Logo emerged from its context of production more suited to some uses than others, that it carried forward to the context of use certain preferred meanings. Yet, chapters Seven to Nine demonstrated that whatever these biases at the level of production may be, their power to control what ultimately occurs is only partial. Chapter Seven has illustrated that -although particular cultural meanings may be ascribed to a technological artefact like Logo throughout its production process- there is a lot more to say about what happens to this technology on its way to its context of use. As chapters Eight and Nine have demonstrated, there is, in fact, even more to say once the artefact reaches its context of "consumption" whereby it is re-constructed and appropriated:

> A technology's biases may establish a set of initial conditions favoring one or another outcome, but the drama of what actually does transpire cannot be foretold... What we find, perhaps not surprisingly, is that while the introduction of new technologies does create an altered situation in some ways, preexisting power relations most often find a way to shape usage of the new technology so as to re-establish themselves, simply in a different form (Bromley, 1995, chap.2:2).

In line with the principal conclusions derived from our discussion of sociological approaches to technology in chapter Two, Three and Four, chapters Seven, Eight and Nine have demonstrated that <u>to suggest that once a technology is produced it reaches the end of its social shaping, is to ignore both its marketing and the power of the context (both social/political and institutional) within which the technology comes to be "consumed"</u>. Chapter Seven in particular has provided evidence of this close articulation between production and "consumption", by illustrating how commercialisation and marketing (mainly in the US context) were significant forces in the social shaping of Logo, not only in that they informed design but also in that they played a part in constructing demand and "consumption" by evoking meanings for teachers, learners and others which were derived from, and acted as, cultural symbols. The same chapter has demonstrated how marketing decisions, the competition developed between commercial companies, the politics involved in the development of different Logo versions, and the colonisation of education by the microcomputer industry, have shaped the Logo product which came to be "consumed" in school classrooms. In addition, it has provided evidence that, upon the re-contextualisation of Logo in the UK, domestic economic forces (including the microcomputer industry) have played a significant role in shaping both the Logo product that came to be used in British classrooms <u>and</u> the ways in which this product would tend to be used.

A general conclusion deriving from the discussion of the implementation of Logo in mainstream schools is that educational innovation and change is a multidimensional thing. This means that significant changes at a number of levels are required at the same time if transformational developments are to occur. The success of an innovation like Logo was not simply a question of whatever should be done with the particular technology by itself; it required major changes in our standviews about education. For some of the developers of Logo those changes would not occur in a planned and natural fashion; for them Logo was a "revolutionary" idea with subversive effects. As imagined by its developers, Logo encouraged activity which was incompatible with the dominant conception of the 40-minute-class fragmented curriculum and called for major changes in understanding the nature of schooling and education.

However, despite the radical intentions of its creators, Logo as practised within mainstream educational structures was -with few exceptions- quickly absorbed by existing structures, to become a reinforcing agent of the traditional rather than a vehicle of the new. It was variously embraced and resisted, "normalised" and institutionalised, in the effort to perpetuate a conservative school system. This depressing conclusion is not surprising. The work of Basil Bernstein (1990, 1996) has led me to anticipate that, even though the introduction of Logo appeared to have some of the characteristics of "integrated codes" (as discussed in Chapter Six), it would be difficult for it to challenge the strong subject-based "collection code" dominating (especially) secondary education (see also Whitty, 1994:27). The work of Jennifer Gore also (Gore, 1993) has similarly guided me to think that -despite the best of intentions to achieve something different- the organisational structures of schools and the power relations implicit in the pedagogic relations often pull things back to something much less radical:

> ...it is not enough to dream of an alternative classroom; the vision needs to acknowledge what already exists and the specific constraints which confront it (Gore, 1993:86).

An implication of this point is the conclusion that part of the literature on Logo (especially professional teacher journals) seems to have for a number of years exaggerated the degree to which Logo can make a difference. Because at the end there is not such a thing as Logo-in-general; the meaning of "Logo" is negotiated, constructed and re-constructed in any classroom according to the priorities, beliefs, and backgrounds of the participants. "Logo" -like any other educational innovation- does not get into a culture-less environment; it is inserted in a context where it remains both the object and subject of struggles over meaning. As the cultural studies framework informing this study has suggested (in Chapter Four), this is the case with any technology; Logo is not so much being "implemented" or "consumed" in schools as being "re-created", not so much "reproduced" as "produced".

3. Logo: an inherently political technology. Chapters Seven through Nine have suggested that the practical realisation of Logo in mainstream schools is -generally speaking- at variance with the promise. In its "normalisation" within the curriculum, Logo is no longer about building and reflecting upon knowledge, no longer about changing and evolving cultures. I have demonstrated that a large number of factors worked together to mute the impact of Logo on the educational system and to prevent the realisation of the potential for far-reaching radical change inherent in its use. Is this an inevitable pragmatic resolution of its developers' radical vision? Has this happened simply because of lack of vision? limitation of resources? or the absence of commitment to this form of educational practice? It is not easy to say. A review of previous attempts at educational reform shows that the propagation of ideas in educational establishments takes a lot of effort and requires the development of a tremendous infrastructure which in the case of Logo had not been developed prior to implementation. From this conventional point of view, it seems that being in a state of inventive mindset and excited by the introduction of micros in schools (as some members of the MIT Logo group admit), some of the developers of Logo (the "revolutionary" strand discussed in Chapter Five) introduced it into mainstream schools in a rather utopian manner, without adequate consideration of earlier attempts at educational innovation, expecting that part of the necessary infrastructure would develop in the process.

However, I have suggested in this thesis that understanding why Logo failed to penetrate existing educational structures goes far beyond conventional explanations of approaches which view educational innovation simply as a matter of implementation. I argued that for a fuller account we ought to turn our attention to the fact that Logo is strongly compatible with- and thus for its success it requires the creation and maintenance of- a particular set of social conditions as its operating environment. In this sense -and this is a major conclusion of this thesis- Logo, similarly to other technologies, <u>is by its very nature an "inherently political" technology</u> (Winner, 1985) in a sense that it is a device strongly compatible with particular kinds of socio-political relationships; its fundamental principles, its "philosophy" for education, and its structural design have been strongly, perhaps unavoidably, opposed to patterns of power and authority dominating our schools in the conservative restoration of the 1980s. Analysis of "moments" four and five of Logo's circuit of production (*context* and *consumption*) has suggested that there has been a very uncomfortable relationship of the "Logo text" as a "radical" and "emancipatory" pedagogic discourse with both the dominant institutional structures of schools and the conservative restoration which characterised the educational systems of both the US and the UK in the early 1980s. It has been suggested that the disintegration of "progressive" education largely constituted the context for the "decline" of Logo during the process of restructuring of formal education in the 1970s and 1980s.

As a corollary of this point, a related conclusion which we can derive is that Logo was introduced into mainstream schools too late; in the adverse political climate of the early 1980s which minimised the autonomy of teachers, it is not surprising that Logo penetrated existing school structures only minimally. Apart from the power of the social and political context within which schools operate, the power of the school itself as an institution to trivialise attempts at innovation should not be underestimated: schools are sites of powerful forces which shape what goes on within them, and what is taken to be 'knowledge' or 'worth knowing' is constituted by these forces. In this respect, my analysis has suggested that there has been a serious mismatch between the notions of the learner and knowledge exemplified in the original idea of Logo and the aims of schooling as traditionally understood even before the 1980s. Given this gap, evidence has suggested that the personal costs for teachers were very high when they tried to implement different ways of teaching and learning within organisational structures and belief systems that prevented anything more than a passing embrace of neo-progressive notions. The price they had to pay in trying to put into practice different views of knowledge, learning, teaching, and the roles that adults play in schools was especially high in the middle of a conservative restoration which increasingly demanded accountability and control.

However, after the brief mention of the *Bridgewater* counter-example, the question arises once again of which way (and to what extent) the context shapes the use of Logo: do preexisting power relations in schools and classrooms shape Logo use so as to reinforce those very inequalities, or is the user community able to appropriate Logo locally for transformative ends? My answer has been rather pessimistic. It seems that in essence, the possibilities for creative or open-ended uses of Logo are not frequently the case in contemporary mainstream schools, a conclusion of striking similarity to the findings of research by Bromley (1995) who argues that:

> Although isolated "success" stories are sure to crop up even under current conditions, like weeds in the cracks of the status quo, enabling these growths to flourish into a thriving patchwork of alternative practices will require some fundamental changes in the technocratic regime that now governs what happens in schools (Bromley,1995, chapter 4:9).

Thus, another general conclusion that I have been drawing from the discussion of Logo as a case-study in educational innovation is that <u>pre-existing social relations were largely able to utilise the new technology as an avenue for reasserting themselves, thus reinforcing the status quo</u>. Put into what were growingly conservative mainstream school settings, something that the Logo community had seen as quite unusual and "revolutionary" about the computer culture no longer was the main event. At the end of the day, in the great majority of both UK and US schools Logo ended up seen most often:

> as an elementary geometrical program, or simply as an exercise in enjoyable computer interaction. In secondary schools, the situation was complicated by the tendency to ghettoise machines into laboratories where they were used for "computer studies", and if Logo was used at all, it was used in the context of "teaching programming" rather than as a means of expressing mathematical ideas (Noss, 1993a :3).

Logo was marginalised, remoulded as harmless to the educational organism, redrawn as "a programming language" or "a drawing tool" rather than as any kind of catalyst for rethinking the content of what is or what needs to be taught. It was largely assimilated into existing educational structures, to the disappointment and bitterness of its original developers as the following quotation by Wilensky indicates:

Schools... ate up Logo and spat it out as just another little school thing... they took the heart out of it; it became just as alienating and just as pointless as most other things in school (24).

From an Australian perspective, Bigum reported a similar conclusion as early as in 1986:

Like a lunatic under a regiment of mind-altering drugs, Logo is rendered non-controversial or made non-problematic as it adapted or built into existing practices. It undergoes a translation, a reinterpretation so that it eventually becomes comfortable, a part of the curriculum furniture. Any potential Logo may have had for posing questions about current practice is blunted by its incorporation into existing practices and curriculum (Bigum, 1986:195).

As an overall conclusion which connects the case-study to the early chapters of this thesis and the discussion of technological determinism, I want to point to the fact that the reality of Logo's implementation in mainstream schools provides an exemplary case-study against notions of technological determinism, testing the degree to which change comes from technology or has to come from the social milieu. The case of Logo demonstrates that the introduction of technology alone cannot possibly bring about radical change, that the medium alone cannot carry the entire message. The discussion of the distance between the original expectations and the reality of implementation shows that the technology needs to be surrounded by social and political relationships that will allow it to do transformational work; this is exactly what Sherry Turkle argues in a quotation which resonates with my argument in chapters Eight and Nine of this thesis:

Logo would have looked very different if it had been out there and developed at a point when a lot of progressive education ideas existed -like in the early 1960s- where there were new progressive schools in every place and everybody wanted to experiment with being a teacher...But it didn't really get out into the world until the early 1980s when we had a much more conservative, retrenched, back-to-basics kind of period. So in a certain way this radical technology was actually deployed at a very conservative moment in people's thinking about education, there is a kind of fundamental mismatch... At the time Logo came onto the scene there were also progressive schools [e.g. *Lamplighter*] but I think the attitude in general was a kind of 'back-to-basics'. So I think that it [the introduction of Logo] really is a wonderful test-case for these notions about the interaction between the technical object and the surrounding culture... the surrounding culture won (22).

4. Recommendations for further research. An additional conclusion emerging from this discussion of Logo is that any attempt at educational innovation should recognise schools and classrooms as social organisations that both influence the way in which any new technology will be adopted and are influenced by that technology in sometimes unanticipated ways. In fact, a long history of research on educational reform suggests the importance of an awareness of the ways in which the structural and organisational aspects of educational systems influence the adaptation of innovations. In the foregoing chapters, we have seen the resistance to Logo in action. In order to enter the educational domain, Logo was altered in the image of that domain, fragmented, and compartmentalised. Yet, Logo is only an example; in thousands of tiny struggles facing millions of children and teachers, the dilemmas will be the same, shaped partly by the strong notions students and teachers share of the hierarchies of position and power in institutionalised education.

There is little reason to think that things will be different with multimedia computers and telecommunications networks which are the current fashion in education. The recent claims that new technological products like CD-ROMs and the Internet will provide teachers and students with learning environments of unparalleled richness border the hyperbole[89]. The case of Logo demonstrates that a particular combination of hardware and software may be utilised in very different ways in different contexts, for very different ends and with very different results. In this sense, the task of introducing multimedia and telecommunications technology into schools is more than the relatively straightforward insertion of physical objects with remarkable properties into an ongoing social milieu with no important coincident adjustments in that milieu. The view that ICTs will suddenly revolutionise education is most likely mistaken. Hardware and software by themselves cannot and will not have such an impact. They are social and cultural as well as technological objects. Their production takes place within the arena of market competition; and their "consumption" is subject to the vagaries of both the broader social context and the specific institutional context within which they are used.

Policy-makers faced with the task of deciding how much money to spend on technologies for education might prefer an unambiguous answer about the implications of such purchases. However, it is vital to recognise the extent to which any impact is likely to depend on factors all the way from economic realities that determine the production of hardware and software, to very specific design decisions made on the part of software developers, to assumptions that determine the nature and amount of training teachers receive; to organisational norms, values, and practices that influence when, how, and by whom the technology is used. One can then attempt to understand the influence of these factors rather than assuming that the important decisions have been made once the equipment has been purchased. The discussion of Logo has demonstrated that understanding the full educational impact of any technological innovation necessarily involves matters well beyond the technical, and even well beyond the classroom. It has been argued that pre-existing attitudes and social structures largely shape the extent to which a technology is used as well as the way it is used. The fact that a particular technology is available in a classroom does not automatically mean that it will be used at all, or that it will be used in a particular way and style. For one thing, ongoing social dynamics in the classroom, long predating the introduction of multimedia or any other computer-related products, are of crucial importance. No matter how painstaking their design, what actually happens when these resources reach the classroom will depend partly on what's already going on in that classroom, as Papert himself has forcibly argued:

> The challenge to school, in its traditional forms, cannot be made by simply dumping computers and computer languages, however well designed, into classrooms. The schools will assimilate the computer to their traditional culture... A more effective answer ... would consist of extending computer criticism beyond technocentrism: it would call into question social structures and cultures that existed before the computer (Papert, 1990:20).

Today, we are sometimes led to believe that the technological market genie is out of the bottle. Yet, serious sociological work on these developments is in short supply; once again, the production of sociological research on the educational implications of these technological innovations is out of pace with their rapid invasion of classrooms. I suggest that the conceptual, methodological and analytical tools used in this project for the discussion of Logo as a case-study could be usefully deployed for the sociological study of other technological products used in education, including multimedia and telecommunications. Considering, for example, the *Internet* as a cultural product in education, we could spin it through its own "circuit of production". Because -similarly to Logo- what makes the *Internet* part of our culture is not only the "work" which has gone into constructing it meaningfully as a technological achievement, but the social practices with which it has become associated. We *do* various things with the *Internet* in educational environments, as we do with Logo. We make use of it in certain ways and thus give it significance, meaning and value within the life and culture(s) of our educational institutions, just like what we do with Logo. There are a whole set of practices associated with it which define what is culturally distinctive about the *Internet*, as is also the case with Logo. Each of these different practices carries its own assumptions and cultural load. By situating the *Internet* in these different practices, we appropriate it into our culture and expand its cultural meaning or value, which is also what gives Logo its cultural significance. Therefore, analysing the lineage of the *Internet* through such a flexible cultural studies approach may offer valuable windows to the intersection between technology, society and education. Such a study would allow us to further explore the theoretical and empirical adequacy of my modified version of Johnson's circuit of cultural production.

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APPENDICES

APPENDIX A

List of academic and professional journals used in this study

ACM Sigplan Notices

ACM Transactions on Programming Languages and Systems

Annals of the History of Computing

Artificial Intelligence and Society

Australian Journal of Education

British Journal for the Philosophy of Science

British Journal of Sociology of Education

Cultural Studies

Discourse: studies in the cultural politics of education

Educational Technology Abstracts

EuroLogos

History of Science

History of Technology

IEEE Annals of the History of Computing

IEEE Technology & Society Magazine

International Studies in the Philosophy of Science

ISIS: an international review devoted to the history of science and its cultural influences

Journal of Educational Computing Research

Logo Update, The Logo Foundation Newsletter

Logos

Logo Exchange

Media, Culture, and Society

Micromath

Philosophy of Science

Radical Philosophy

Radical Science

Science as Culture

Science in Context

Science, Technology & Human Values

Social Science Quarterly

Social Science Computer Review Journal

Social Studies of Science

Social Text

Studies in History & Philosophy of Science

Technology & Culture

Technology Review

Theory and Society

Theory, Culture and Society

Wired

APPENDIX B: Interviews (in alphabetical order by name)

NAME OF INTERVIEWEE	CURRENT PROFESSIONAL ID	LOCATION OF INTERVIEW	DATE	NO.
HAL ABELSON	Professor of Computer Science and Education, MIT	MIT	22 February 1995	(1)
JANET AINLEY	Lecturer in Mathematics Education, Warwick University	Warwick University, UK	December 1994	(2)
JOHN BERLOW		Boston, Mass.	22 February1995	(3)
PETER BUTT	Senior Teacher of Mathematics, London	City of London School	20 October 1995	(4)
AL CUOCO	Curriculum Developer, EDC, Newton, Mass.	EDC, Newton, Mass	25 February 1995	(5)
MIKE DOYLE	Secondary Teacher of children with learning difficulties, Chairman of the Scientific Committee of EuroLogo	Telephone interview	19 October 1995	(6)
WALLACE FEURZEIG	Principal Scientist, BBN	BBN headquarters, Boston	21 February 1995	(7)
PAUL GOLDENBERG & DAN WATT (common interview)	Curriculum Developers, EDC, Newton, Mass.	EDC, Newton, Mass.	25 February 1995	(8)
RONNIE GOLDSTEIN	Project Officer, NCET, former mathematics teacher	Telephone interview	3 November 1995	(9)
BRIAN HARVEY	Member of the Computer Science Department, University of California at Berkeley	Institute of Education	July 1995	(10)

continued

CELIA HOYLES	Professor of Mathematics Education, University of London Institute of Education	Institute of Education	January & June 1995	(11) & (12) resp.
YVETTE KINGSTON	Primary Teacher	Warwick University	2 December 1994	(27)
URI LERON	Professor of Mathematics Education, Technion University of Haifa, Israel	Institute of Education	January 1995	(13)
HENRY LIEBERMAN	Member of the MIT Media Laboratory	MIT Media Lab, Boston	23 February 1995	(14)
GEORGE LUKAS	Associate Professor of Computer Science, University of Massachusetts Boston	Boston	20 February 1995	(15)
RICHARD NOSS	Professor of Mathematics Education, Institute of Education University of London	Institute of Education	18 October 1995	(16)
MARIA OLIVEIRA	Secondary Teacher of Mathematics, Elizabeth Garrett Anderson School for Girls, Islington, London	EGA School for Girls, London	January 1995	(17)
SEYMOUR PAPERT	LEGO Professor of Mathematics, Education and Computer Science, Head of the MIT Media Laboratory	MIT Media Lab, Boston	23 February 1995	(18)
DAVID PRATT	Lecturer in Mathematics Education, Warwick University, former mathematics teacher	Brookhurst Primary School, Leamington, Spa, UK and Warwick University	December 1994	(19)
MITCHELL RESNICK	Assistant professor of media arts and sciences, MIT Media Lab	MIT Logo Lab, Boston	24 February 1995	(20)

continued

BILL TAGG	Secretary of the Society of Education Consultants, UK, former Director (1982-1991) of the Advisory Unit on Microelectronics Education, Hatfield, UK	Telephone interview	6 November 1995	(21)
SHERRY TURKLE	Professor of Sociology, MIT	MIT, Boston	24 February 1995	(22)
MOLLY & DAN WATT (common interview)	Curriculum Developers, EDC, Newton, Mass.	EDC, Newton, Mass.	25 February 1995	(23)
URI WILENSKY	Professor of Mathematics Education and Computer Science, Tuffts University, associated with the MIT Media Lab	Tuffts University, Boston	25 February 1996	(24)
MARGARET WILLIAMS	Primary Teacher, St. Benedict's Junior School, Ealing, London	St. Benedict's Junior School, Ealing, London	December 1994	(25)
JOHN WOOD	Consultant in Education, former lecturer of Mathematics at the Open University and the Imperial College	Institute of Education	2 November 1995	(26)
Unattributable interview 1				(28)
Unattributable interview 2				(29)

APPENDIX ONE

The introduction of microcomputers in US and UK education: social and political context

Educational reform in the post-Sputnik era. After the explosion of atom bombs in Japan at the end of World war II, the United States had made clear that their powerful role in the new world order was partly due to their technological supremacy. The launch of Sputnik by the Russians in 1957 came as a devastating blow to their global scientific and technical prestige, it was threatening their world position in the middle of the Cold War. The feeling that the US had fallen behind in the "technological race" sparked an obsession to reassert the supremacy in science and technology. As a response to the shock, the government, the military and industry urged for increased expenditure in space research and on science education with an aim to create a scientifically prepared generation which would overturn the defeat. The fear of the Russians being more technologically advanced and ahead in space exploration fired an immediate response to invest enormous resources and effort in developing an educational reform which stressed science and maths education. The direct effects of this response were felt throughout American education for at least a decade afterward.

In 1958, Congress passed the National Defense Education Act (NDEA) which provided $1 billion for training America's youth in areas in which the Soviets seemed to excel: science, mathematics and foreign languages. The overt goal of this and other funding bills over the next decade was to train a sufficient segment of the population so that there would be a large pool of people with the background to become scientists. Coupled with increased spending for scientific research and development, this would help US retain competitiveness. The NDEA strongly emphasised the technological aspects of education. Title III of the Act authorised $75 million per year for 4 years as matching funds for schools to purchase equipment for use in the three favoured subject areas. Title VII authorised $13 million for instructional technology.

This enormous financial investment in science and maths education had a tremendous impact on the entire education system and its curriculum. Among other consequences, the emphasis on a few key subjects rendered the rest of the curriculum be seen as subordinate to these and a positivist scientific approach was coming to dominate educational reform. The dominant notion was that the development of the right kind of curricular content would be the key-element. In addition, educational practice became more sharply defined in terms of behavioural objectives, efficiency, and predictability of outcome. Thus, within this discourse of educational "reform" which was dominated by economic and nationalist interests, it comes as no surprise that Computer Assisted Instruction (CAI) with drill-and-practice programs --which made easier the measurement of students' performance on standardised tests --became the dominant paradigm for the introduction of computers in education:

> During the post-Sputnik period there was a major effort to build mathematics and science curricula to catch up with the Russians. The notion that some people had then was that if you developed the right stuff, the right kind of curricular content, that would do it... and similarly the same kind of thing was reflected in terms of the prevailing notions about what computers and technology could do: it was programmed instruction done with computers, CAI was the early version of it (7).

Microcomputers appeared in American classrooms during that period of major curricular reform, simultaneously with an outpouring of special reports on the crisis of American education. The first report *A Nation at Risk* (National Commission on Excellence in Education, 1983) was commissioned by the secretary of education and it was followed by a series of other reports: *Educating Americans for the 21st Century* (National Science Board Commission on Precollege Education in Mathematics, Science and Technology, 1983); *Action for Excellence* (Task Force on Education for Economic Growth, 1983) from the Education Commission of the States; and *Making the Grade: Report of the Twentieth Century Fund Task Force on Federal Elementary and Secondary Education Policy* (Twentieth Century Fund, 1983).

A common element of these reports was that they emphasised a back-to-basics education with a more structured curriculum, longer school days and school years, a minimum number of hours per day to be spent on specific disciplines (especially maths and science). The reports combined the kind of socialising themes that were seen in early moves toward compulsory education with the maximization principle and the emphasis on science and technology which were seen in the post-Sputnik era. All the reports presumed that the state of education was directly related to America's position in the world and its ability to remain competitive and strong against international economic rivals. Claiming that education was tied to larger economic issues such as national survival and international competition from countries like Japan and (then West-) Germany, the reports claimed that America's future success as a nation depended on its ability to improve education. Grounded on the argument that educational reform was necessary to support the United States retain its competitive edge internationally (both economically and politically), recommendations tended to stress math and science instruction, vocational training, and "computer literacy".

The rash of reports demanding the "improvement in educational standards" was part of what Apple (1993) calls "the conservative restoration in US education" in the early 1980s. The American Right was identifying such elements as desegregation, the integration of pupils with special needs into normal schools and the ideal of educational equality as being responsible for the decline of educational standards. Reagan's National Commission on Educational Excellence (NCoEE) blamed the curriculum offered by American high schools and called for the return to "older values" through the introduction of "five new basics": English, mathematics, science, social studies and computer science. By describing computer science as one of the "new basics" schools should teach, the NCoEE forcibly demanded that knowledge and use of the computer should become an essential requirement and priority in order to preparing children for a "computer-rich society":

> The people of the United States need to know that individuals in our society who do not possess the levels of skills, literacy and training essential to this new era, will be effectively disenfranchised, not simply from the material rewards that accompany competent performance, but also from the chance to participate fully in our national life (NCoEE, 1983:468).

The US National Foundation went even further in its report saying that all high-school students should know basic computing terminology and be familiar with one high-level language. The reports encouraged and intensified the acquisition of computers by schools and the provision of "computer-literacy" courses under the dominant rationale of the "economic efficiency" model of education. The campaign was also taking on a nationalistic image and official support linked to the argument that the nation's economic performance and the world of work depended on a re-tooled education service:

> Through most of the 1980s, computer literacy was perhaps the most rampant educational fad in the USA. The various programs touted as conferring computer literacy have little specific content in common. What they share is their rhetorical wrapping: a vague appeal to the dawn of the information age and the consequent need for all children to acquire some ill-defined familiarity with computers in order to keep up with the times. Most such statements forecast impending doom for the nation as we are overtaken by our international economic competitors (Bromley, 1992:131).

It does not seem coincidental to me that the rush for computers in education developed at the same time as the broader restructuring of the education system; rather I see it as part of the re-shaping of education by the industrial lobby within a populist framework.

Despite the enormous rhetoric, when microcomputers became available to schools in 1980 it was far from clear what would be the best way to use them. The available software was basically computer-assisted instruction (CAI) programs which were often poorly developed and thoughtlessly utilised, and programming languages. In addition to CAI, programming was thought of as offering opportunities for problem-solving and intellectual development. At the same time, the new agenda for action for the 1980s of the National Council of Teachers of Mathematics (NCTM) was promoting the use of computers in mathematics. It was making it clear that "children should use computers" for different sorts of mathematical activity and learning and made schools feel they needed to have computers for mathematics.

Within this setting Logo programming language became commercially available on the Apple II microcomputer in 1980 (and soon afterwards on other microcomputers, too) and was introduced in tens of thousands of elementary classrooms throughout the United States. Since then, it has been heralded as the programming language of choice for elementary school students, whereas BASIC has been regarded increasingly as appropriate for junior high school students. The school year 1983-84 was one of incredible growth for Logo in the US. Thousands of teachers across the country started to use it in their classrooms; classrooms all over the country began to "teach" Logo to students, primarily in grades 3-6. More and more versions were being released for more and more computers. Several Logo books were being published, and more were on the way. Nearly every educational computing magazine now had a Logo section. The August 1982 issue of the American magazine BYTE was almost exclusively devoted to Logo presenting it in its annual language issue. By 1984 Logo was available to millions of people, in homes, schools, camps, libraries, even on television. Those who were part of its formative years (and even more those who had been commercially involved with it) were extremely gratified to see Logo's widespread use all over the country and in many other parts of the world. By summer 1986 approximately 150,000 copies of Logo had been sold for the Apple II family of computers in the US and Canada.

British government policy for IT in education between 1970 and 1985. On the other side of the Atlantic, accounts of the history of IT in education in Britain recognise the central government as the most important party promoting the introduction and use of computers in education in the last two decades; developments in IT in education in Britain have been steered by government policy through a series of state-directed "innovations" particularly in the period since 1981 when the Microelectronics Education Programme (MEP) was launched. Although there has been some incoherence in policy "unusual for a democracy" (Somekh, 1993:12) resulting from the independent entrepreneurial stance of several government departments in the UK under the Thatcher administration, there has been some consistency in allocating funding to establishing computers in education (although not to developing any coherent aims or means of support) and this resulted in much greater co-ordination and regulation of policy and practice than in some other countries.

Government promotion of schools computing, however, can be traced back at least as far as the 1969 Scottish initiative, the interim Bellis report of the Computers and the Schools Committee which advocated the use of computers across the curriculum. The National Council for Educational Technology was first formed in 1967 and reconstituted to form the Council for Educational Technology (CET) in 1973. CET was funded directly through the government's education departments, and its remit covered all parts of the United Kingdom, and all aspects of education and training. It provided a focal point for the collection and dissemination of information and advice on educational technology. The first national programme to address IT in education directly was proposed at the end of the 1960s. In 1969 a feasibility study on "Potential applications and development of computer-based learning systems" recommended to the DES that a national development programme in computer-assisted learning, NDPCAL, should be set up. This was done in 1972 and the aim of the programme was to develop and secure at reasonable cost the assimilation of computer-assisted learning on a regular institutional basis. Boyd-Barrett (1991) provides a summary of this early phase:

> Prior to the DTI scheme for England and Wales 1981-84, "computers were thin on the ground, especially in primary schools. The pattern was uneven, reflecting individual (LEA, school, teacher) enthusiasms and histories" (CARE, 1988), and "piecemeal, with wide local variations" (Gwyn, 1987:40). State involvement was largely indirect. During the 1970s, the Schools Council (funded by the DES and the LEAs, but largely teacher controlled) produced materials in five subject areas based on interactive computer programs. Through the DES-funded Council for Educational Technology (CET), the Government established the National Development Programme in Computer-Assisted Learning (NDPCAL, 1973-77) a £2.5 million project restricted to higher education. The roles of the Schools Council and NDPCAL have been described as a "typically British form of central support function with no central control" (Gwyn, 1987:10). Closure of the Schools Council in 1982, reflected government disappointment with the take-up of its many curriculum projects (Boyd-Barrett, 1991:6).

The 1980s were marked by the development of the MEP which ran from 1981 to 1986. Throughout the decade it was the intervention of government, first and foremost, that constituted the driving force of computer adoption in schools moving progressively from an initial relatively open-ended period of exploration in the first half of the decade to a gradual sharpening of policy goals and the implementation of curriculum compulsion through a top-down model of educational innovation in the second half. Apart from central government, the industry (mainly through the DTI) has promoted hotly the expansion of IT in education. Major initiatives were sponsored by the Department of Education and Science, the Department of Trade and Industry and the Employment Department through the Manpower Services Commission (MSC) (for a list see Appendix Two). These Departments adopted rather different strategies and encouraged different kinds of approach.

In 1978, the DTI launched the business-oriented Microelectronics Awareness Programme (MAP) which took the form of training workshops, funding of college courses and of the Open University course on the Microelectronics and Product Development in 1979. MEP was launched in 1980 by the DES on a reduced budget of £9 million (the initial 1978 design had announced a £12 million scheme), although the project was later extended by two years to 1986 and spent a total of £23 million. The final MEP blueprint appeared in April 1981. It was organised in the form of a small national directorate and 14 regional centres (whose boundaries were determined by groupings of the 104 LEAs participating in the management of the scheme). Gwyn (1987:47) argues that the regional strategy emerged as a highly innovative, in UK terms, development ploy which "avoided the centralised direction which would be unacceptable in the UK and also overcame the intense localisation of development which is the norm" (a sensitivity which was evidently lost after the 1988 Education Reform Act).

MEP priorities were the dissemination of information, teacher training, curriculum and software development with reference to specified subject areas. Accounts of MEP (Boyd-Barrett, 1991; Gwyn, 1987,1988) seem to generally agree that, while the MEP helped establish considerable, persistent pressure on the educational system to take microelectronics seriously and to integrate it into the curriculum, "in effect, government intervention at this stage did not so much define a policy as provide the means whereby activity would be generated of a sort that could lead to a policy or series of policies" (Boyd-Barrett, 1991:8). At that stage, the intervention of DTI provided the funds (through its *Micros in Schools* scheme, 1981-84) offering 50% subsidy towards the purchase by schools of their first microcomputer. The offer was independent of school size and the aim was to get one micro into every secondary school by the end of 1982. The scheme was extended to primary schools in July 1982. The choice of machines was limited and all the machines were British. Data provided by Moore (1986) show that in 1984, 73% of all primary schools and 78% of all secondary schools had a BBC B microcomputer.

The MEP ended in 1986 and it was succeeded by Microelectronics Education Support (MESU) in January 1987. In 1988, MESU was integrated with CET to form the National Council for Educational Technology (NCET). The DTI continued as a funding agency, in particular for education and training in microelectronics, for which it disbursed a total of £21 million per year, primarily through IT centres set up jointly with the MSC (reporting to the Department of Employment) for 16/17 year-olds. £45 million was provided to create additional engineering and technology places in higher education. A three-year, £3.5 million project, "Software in Schools", which offered grants to schools towards the purchase of software, and a similar £ 1.5 million project, "Modems in Schools", were both launched in 1986. DTI's software subsidy was extended to 1989. Further funds for IT were channelled to education through the Manpower Services Commission (MSC) via its Youth Training Scheme (YTS) for 16/17 year-olds, TVEI to influence the curriculum of 14-18 at school, and City Technology Colleges (which started in 1988).

In the mid to late 1980s, government involvement and direction showed signs of renewed vigour in both monetary and policy terms. In 1985, the Scottish Microelectronics Education Committee published a national plan advocating the setting up of Regional Development Units and the specification of programmes by local subject groups. The HMI 1987 report on Learning and Teaching in Scottish Secondary Schools as well as the 1989 HMI report *Information Technology from 5 to 16* (DES, 1989a) identified aspects of “best practice” and suggested “ways forward” for more concerted developments. Also in 1987, the UK government circulated LEAs with proposals for *New Technology for Better Schools*. The centre of government focus had shifted from preparing children for the "information society" to helping them learn in general. The document promised more money for hardware (£8.5 million), the training of 700 advisory teachers (which was undertaken by the MESU, another £10.5 million), and continued software support. A coordinated cross-curriculum policy was encouraged, linking computing with other sources of funding. The proposals heralded the start of a five-year plan, the first two years with guaranteed funding.

New Technology for Better Schools provided resources but still no formal compulsion to use computers across the curriculum. Compulsion began to emerge with the 1988 Education Reform Act which subjected England and Wales to the National Curriculum. Information Technology did not appear as a core or as a foundation subject, but it was an integral part of all programmes of study and many attainment targets, including the English Language curriculum which sported many references to word processors and information retrieval (DES, 1989b). According to Boyd-Barrett (1991:12), by the closure of this period, the nature of government intervention had undergone profound shifts which were likely to characterise the 1990s, and in three major directions: greater clarity and focus of objective (namely, the improvement of teaching); more persistent attention to resourcing and training; more direct control over the curriculum.

Overall, the amount of central government money spent on implementing policies for IT in education between 1980 and 1992 was substantial: a sum of at least 117 million pounds over twelve years. What is more important perhaps is that the inspiration for all this spending on IT in education came from ambitious, male, government ministers, within Thatcher's radical conservative administration, who apparently believed that development in IT would rejuvenate the fortune of Britain or, if not, that it would create for themselves as Ministers a dynamic, go-getting public image. Kenneth Baker was a central figure:

> I always wanted industry to put money into education and I think that significant IT developments in the future will require that kind of partnership (Kenneth Baker quoted in Kenny, 1995:26)

> I made schools an offer that they could not refuse: subsidised state funding to get the computers in (Kenneth Baker quoted in Kenny, 1995:26).

APPENDIX TWO

Major UK government initiatives in IT in Education between 1980-1996

- The Microelectronics Education Programme (MEP) 1980-86: 23 million pounds from the Department of Education and Science (DES).

- The Microelectronics Education Support Unit (MESU) 1986-91: 3 million pounds annually from the DES.

- Micros in Secondary Schools 1981-84: 5.6 million from the Department of Trade and Industry (DTI).

- Micros in Primary Schools 1982-84: 9.5 million from the DTI.

- Software scheme 1985-88 (primary and secondary schools): 3.5 million pounds from the DTI.

- Modems scheme (secondary schools) 1986: 1.5 million from the DTI.

- NERIS database (National Educational Resources Information Service) 1986: 3 million pounds from the DTI, later supported by the DES and the Welsh office (WOED).

- Hardware scheme 1987 (primary and secondary schools): 3.5 million from the DTI.

- Interactive Video in Schools Project 1986-88: 2 million pounds from the DTI.

- National Council for Education Technology (for establishment and initiatives) 1988-: 5 million pounds annually from the DES.

- Interactive Video equipment grant 1988 (secondary schools): 1 million from the DTI.

- Software grant for initial teacher education 1989 (up to 500 pounds per institution conditional on matched funding from the institution itself).

- The Education Support Grant for England 1987-93 (IT in Schools strategy): 90 million pounds from the DES (for advisory teachers and hardware).

- The Technical and Vocational Education Initiative (TVEI), Pilot Project, 1983-87 (for secondary schools): 240 million from the Employment Department (ED) Manpower Services Commission (MSC).

- The TVEI Extension project, 1987-97: 900 million pounds (maximum) from the ED Training Agency (formerly the MSC).

- National Curriculum Software Development partnership scheme 1991: 0.7 million from the DES.

- CD-ROM and Interactive Video purchase schemes for 1992: estimated 1 million from the DES.

- CD-ROM Development partnership scheme 1992: 0.7 from the DES.

- CD-ROM in Initial Teacher Training 1992-94: 150k pounds from the DES.

- Information Technology in Initial Teacher Training, 1992-94: 150k pounds from the DES.

- *CD-ROM in Primaries* initiative, 1994, managed by NCET on behalf of the DFE. Phase I: 4,5 million pounds for multimedia workstations and CD-ROM titles placed in schools.

- *CD-ROM in Primaries* phase II, 1995: 5 million pounds for 2,675 multimedia workstations placed in schools.

- 10 million pounds for "Superhighways for Education" pilot project, only 500,000 of it from the DFEE (see TES, 22 March 1996).

- "Teaching and Learning Technology Programme" (TLTP) initiative for Higher Education, 1995: 40 million pounds.

APPENDIX THREE

The evolution of cultural studies

The emerging field of cultural studies is itself not a narrowly established theoretical tradition but a flexible set of theories and practices within the social sciences which is dedicated to the notion that the study of cultural processes, and especially of popular culture, is important, complex and both theoretically and politically rewarding. It is regarded not as a discipline but, rather, as an area where different disciplines intersect in the study of the cultural aspects of society. For Turner (1990:11), it would be a mistake to see cultural studies as a new discipline, or even a discrete constellation of disciplines. Cultural studies is an interdisciplinary field where certain concerns and methods have converged; the usefulness of this convergence is that it has enabled us to understand phenomena and relationships that were not accessible through the existing disciplines. Drawing on disciplines as sociology, history, English, media studies and social anthropology, it disrupts the boundaries between them (and therefore also between distinct methodologies) and it cuts across theoretical traditions and methodologies such as structuralism and semiotics, psychoanalysis, discourse analysis, marxism, postmodernism and postmodern feminism. As a consequence of this complexity and multiplicity, cultural studies is not easy to define:

> while the field is now achieving recognition, it is not a discrete or homogeneous theoretical formation, nor it is easy to define (Turner, 1990:1).

In fact, there has been a tendency among cultural studies theorists to consciously resist the development of a theoretical orthodoxy in the field, as it was feared that a conclusive definition or prescription of the field as a stable and fixed field of theory or practice, would soon render cultural studies equally inadequate with the established disciplines already present. For Turner (1990:4), this resistance can be explained as a product of two of the defining characteristics of cultural studies: the complexity and comprehensiveness of the theoretical issues it has confronted in order to deal with the problem of culture, and its commitment to critical political objectives.

The concept of *ideology* has been central to cultural studies and different approaches and researchers in the field have employed different senses of the term. It is one's vision of ideology and its function that determines one's approach to the subject matter and style of argument within cultural studies. Also the relation between the concepts of "ideology" and "culture" is a much debated issue of extreme complexity. For Carey (1989:97), British cultural studies in particular could be described just as easily and perhaps more accurately as ideological studies for they assimilate, in a variety of complex ways, culture to ideology.

British cultural studies. The British tradition in cultural studies, as a distinctive problematic, emerged in the late 1950s and is seen to have begun with two publications -Hoggart's "The Uses of Literacy" (1957) and Williams's "Culture and Society 1780-1950" (1958) followed by "The Long Revolution" (1961). As Bennett et.al. (1981:12) have suggested, the formation of cultural studies as a distinctively interdisciplinary body of theoretical and empirical work concerned with the connections between culture, ideology and social process has largely been paced and conditioned by the tension between two contending perspectives, those of "culturalism" and "structuralism". For quite some time it was customary to perceive cultural studies as split by a broad theoretical and methodological division between these two dominant paradigms.

Structuralists have maintained that cultural forms are not the products but the producers of experience. Therefore, they approached the analysis of culture most often through the analysis of representative textual formations from which one begins to read constitutive cultural codes. The forms and structures that produced cultural meanings were the centre of their attention and the production of meaning here is regarded as a relatively independent or effectively autonomous process. According to Turner (1990:13), the original structuralist stimulus registered within British cultural studies was not a theory of culture, but Saussure's theory of language which directly relates language and culture. Saussure is seen as proposing an analogy between the operation of language and the operation of all other systems that generate meaning, seeing them all as "signifying systems". This analogy has been widely accepted and adopted as it is seen as offering enormous possibilities for the analysis of cultural systems that are not, strictly speaking, languages, but that work like languages. For Johnson (1983:13) the indispensable structuralist contribution has been the recognition that subjectivities are produced, not given, and therefore they can be the objects of inquiry. Structuralist insights, Johnson says, have drawn out the structured character of the forms we inhabit subjectively: language, signs, ideologies, discourses, myths; they have pointed to regularities and principles of organisation and they have strengthened our sense of the hardness, determinacy and, indeed, actual existence of social forms which exercise their pressures through the subjective side of social life. The idea of the "sign" is central in structuralism and semiotics has become a most useful method which enables the analysis of non-linguistic signs and which supplies us with a terminology basic to cultural studies. For Turner (1990:17), semiotics allows us to examine the cultural specificity of representations and their meanings by using one set of methods and terms across the full range of signifying practices: gesture, dress, writing, speech, photography, film, television, and so on.

Culturalists resisted structuralism as too deterministic and too mechanistic and as ignoring the broader social context and practices which powerfully construct forms of subjectivity. According to Bennett et.al. (1981:10), culturalists conceptualise culture as interwoven with all social practices through which men and women actively respond to the conditions of their social existence, creatively fashioning experienced social relationships into diverse and structured patterns of living, thinking and feeling. Thus culturalists define the object of study (the analysis of culture) as "the study of relationships between elements in a whole way of life...[with an aim]...to discover the nature of the organisation which is the complex of these relationships" (Williams, 1961:63). The study of cultural products with symbolic value (meanings) is regarded as inseparable from the study and analysis of the institutions and the social structures producing them. Mostly preferred methods of inquiry here among others are the culturally rich social histories and the "ethnographic" cultural description. Identified particularly with Raymond Williams and E.P. Thompson, culturalism placed much emphasis on human agency as against history and ideology. Culturalists argued that determining forces could be resisted, and that history could be affected by radical individual effort.

However, given the complexity of cultural phenomena, it was becoming increasingly evident that each approach of the two, with its own strengths and limitations, could by no means account for all, while it was also obvious that a synthesis between them would be difficult. Hall (1981:30), argued that neither culturalism nor structuralism was adequate to the task of constructing the study of culture as a conceptually clarified and theoretically informed domain of study. Yet, although the culturalist / structuralist split remained as a division which is seen as a sure impediment to the development of cultural studies (Johnson, 1986:290), it no longer occupies an important place. This is seen as due to the effects of Gramsci's theory of hegemony which resolved many of the points at issue between structuralists and culturalists, particularly the points of determination and social change.

The Birmingham Centre for Contemporary Cultural Studies. While there are now numerous institutions world-wide working in and reshaping the field of cultural studies, the Birmingham Centre for Contemporary Cultural Studies (CCCS) can be regarded as a key institution in the history of the field. The CCCS was established as a post-graduate research centre at the University of Birmingham in 1964 under the directorship of Richard Hoggart, then Professor of Modern English Literature. Its aim was to "inaugurate research in the area of contemporary culture and society: cultural forms, practices and institutions, their relation to society and social change" (Hall et.al. 1980:7). One of the defining characteristics of the CCCS was its resistance to the development of a theoretical orthodoxy in the field, an issue which we have already mentioned. CCCS had rejected a descriptive definition of the field choosing, instead, to embark on "a sustained work of theoretical clarification" (Hall, 1980:15). This foundational feature, however, has recently been relativised due to organisational restructuring and the infusion of undergraduate teaching which the Centre now provides.

In 1969 Stuart Hall became director of the CCCS. Individual and collective research in the Centre was continued and published in collaborative publications, the "specials". However, the work of CCCS was well known before the "specials" due to the circulation of seminar papers, lectures and other working documents called the "stencilled papers" and a journal *Working Papers in Cultural Studies*. Stencilled papers were pieces of work which were reproduced on office equipment and disseminated at a low cost. For Harris (1992:x), this simple idea for publication and dissemination in the 1970s was very effective with CCCS materials and helped the CCCS to be established, at least to those who were on the network, as an exciting, new, interdisciplinary, radical and democratic research grouping at the forefront of things.

Richard Johnson became the third director of the CCCS in 1979. Under his directorship the tradition of "specials" was revived with their 1991 collection.[90] For Turner (1990:76), under Johnson's directorship textual analysis gave way to a sharper focus on history as the centrality of the need to examine everyday life was reaffirmed. Johnson's own interests were focused on the historical construction of subjectivities rather than on media texts. The former CCCS has recently reformed to a Department of Cultural Studies under the directorship of Jorge Larrain offering also undergraduate courses in the field. Turner (1990:80) suggests that this introduction of undergraduate teaching (which happened under funding and organisational pressures) with defined and programmed course units, will affect the Centre's work, it is likely to reduce its output, and possibly its influence considerably.

Although perhaps the most influential, the CCCS has not been the only centre in the British context devoted to the development of cultural studies. We should acknowledge here the work of other "centres" which were developing in parallel with CCCS and further institutionalising a research interest in the field. The Centre for Television Research was set up at Leeds in 1966, the same year as the Centre for Mass Communication Research at Leicester was established. The Glasgow Media Group appeared in Glasgow in 1974. Of even greater importance for cultural studies were the Open University relevant courses and groups especially after 1977, work which is extensively discussed by Harris (1992).

Cultural studies and ideology. *Marxist cultural studies* is a first and broad category of approaches based on marxist conceptions of ideology. In the traditional marxist account, ideology is meant as mystification which serves class interests and has a purely economic cause. A particular ideology is caused by a particular socio-economic system and the function of ideology is towards the perpetuation of this system. Classical marxist theories of ideology have gone under substantial critique and the classical marxist conception of ideology itself is regarded as of limited value for contemporary social analysis (Barrett, 1991). Critiques of marxist reductionism have argued for the "relative autonomy" of culture. For Bennett (1981:7), culture is not simply dependent on economic relationships and cannot, accordingly, be reduced to or viewed as a mere reflection of these, but it actively influences and has consequences for economic and political relationships rather than simply being passively influenced by them. Barrett (1991:vii) suggests that there is a need to move away from the classical marxist conception of ideology, and especially from what is constraining and narrowing in that tradition. Traditional marxism had devalued the importance of the idea of culture but more elaborate conceptions of marxist ideology contested the reductionist implications of earlier marxist approaches and have been regarded as holding a better promise for an adequate theoretical understanding of socio-cultural processes. The work of Althusser and especially that of Gramsci have been much admired and broadly used as alternatives to a limiting early marxist tradition.

Althusser's work marked a conclusive break with earlier conceptions of ideology in that he emphasised the "material existence" of ideology which referred to the embodiment of ideology in the structures and institutions of society, departing thus from a traditional view of ideology as beliefs and ideas. Althusser conceives of ideology as "a system of representations through which people live their relationship to the historical world" and he defends a clear distinction between ideology and science. While classical Marxism had concentrated almost exclusively on production, Althusser advances the thesis that we have to understand "reproduction", an argument that exposes the overemphasis of European Marxism on economism and productivism. Althusser sees ideology not as false but as a conceptual framework through which people interpret, make sense of, experience and "live" the material conditions in which they find themselves; ideology shapes our consciousness of reality. For Althusser, ideology operates not explicitly but implicitly; it lives in those practices, structures and images that we take for granted. We internalise ideology and thus we are not easily made conscious of its presence or effects; it is unconscious and shapes our "subjectivity", our socially produced sense of identity. However, this view of ideology as a massively determining force against which individuals have little power to react, came to be seen as both historically inaccurate and theoretically naive.

The work of ***Gramsci*** was seen as offering a less mechanistic notion of determination and of the domination of a ruling class. Where Althusser's explanation implied that cultural change is almost impossible and ideological struggle futile, Gramsci explained how change is built into the system. He acknowledged the power of the individual human agent within culture and offered a language of possibility and hope. Very briefly, Gramsci's theory of hegemony (that is, a group's moral and political claims to leadership) holds that cultural domination, or more accurately, cultural leadership is a process rather than a permanent state which is not achieved by force or coercion, but is secured through the consent of those it will ultimately subordinate. The subordinated groups consent because they are convinced that this will serve their interests, they accept as "common sense" the view of the world offered them by the dominant group. Hegemony thus offers a more subtle and flexible explanation than previous formulations because it accounts for domination as something that is won, not automatically delivered by way of the class structure.

For Barrett (1991:51), Gramsci's approach to ideology, his theory of hegemony and his detailed attention to questions of culture, and the politics of everyday culture, have all been taken up enthusiastically by a generation sick of the moralising rules and precepts of both the Marxist-Leninist and Labourist lefts. Gramsci's theory of hegemony offered certain advantages for cultural studies analysis and a number of approaches to cultural studies draw largely on it. For cultural studies theorists, Gramsci's theory both includes and goes beyond two powerful earlier concepts: that of "culture" as a "whole social process", in which people define and shape their whole lives; and that of "ideology" in any of its earlier marxist senses, in which a system of meanings and values is the expression of particular class interests. For Bennett (1986), the theory of hegemony has delivered a number of advantages to cultural analysis. First, it has disposed of a class essentialism that linked all cultural expression to a class basis. Second, it has made it possible to examine popular culture without necessarily taking a position for or against its particular manifestations. Third, it has underlined how **movable** the "political and ideological articulations of cultural practices" can be (a specific cultural practice does not carry a particular ideological significance eternally). Finally, for Bennett (1986:xvi), the attack on class reductionism allows for due account to be taken of the relative separation of different regions of cultural struggle (class, race, gender). The power of the theory is its ability to consider individual experience within history, to talk of culture as "the lived dominance and subordination of particular classes", thus incorporating history, experience, politics, and ideology into the study of everyday life.

Gramsci's work offered a more complex definition of popular culture and of ideological struggle and it provided an integrating framework for concrete practical analysis of ideological formations within cultures, as against a mechanical "reading off" of ideological meanings from cultural forms. For a long time gramscianism was enthusiastically embraced as a theory able to explain almost everything. However, Harris (1992) illustrates how the gramscian approach to cultural studies and cultural politics had been able to establish itself at the centre of British work "with both good and bad effects" (Harris, 1992:viii). In addition, the work of Laclau and Mouffe and the appropriation of some of the work of Foucault on power as an effect of certain discourses, have been sources of "enriched" or "elaborated" gramscianism.

The problem of "reductionism" in marxist political theory was identified among others by ***Laclau and Mouffe*** who were critical of those who had tended to see political ideology exclusively as, almost by definition, class ideology. They argue that there are aspects of political ideology that do not fit into an analysis in which political ideology is explained by, or reduced to, the effects of social class interests. For Barrett (1991:80), the work of Laclau and Mouffe, although in some respects tied in a marxist framework, signalises a paradigmatic shift and their challenge to marxism's class essentialism represents "a considerable cracking, indeed a collapse of the Marxist model". Laclau & Mouffe's account of Gramsci's theory of ideology and hegemony in *Hegemony and Socialist Strategy (1985)* stresses his break with the critical conception of ideology, in favour of a positive (which they call "material") perspective and his rejection of the deterministic base/superstructure model of ideology. They maintain that (classical) Marxism is one among several general theories that are not now viable. They argue (1985:3) that "just as the era of normative epistemologies has come to an end, so too has the era of universal discourses". For Laclau and Mouffe, Marxism is founded on a political "imaginary": it is a conception of socialism that rests on the assumption that the interests of social classes are pre-given, the axiom that the working class is both ontologically and politically privileged in its "centrality", and the illusion that politics will become pointless after a revolution has founded a new, and homogeneous, social order. Laclau and Mouffe reject the "class-essentialist" logic of marxism and they go on to identify relations of domination and power in other areas:

> Today it is not only as sellers of labour-power that the individual is subordinated to capital, but also through his or her incorporation into a multitude of other social relations: culture, free time, illness, education, sex and even death (Laclau & Mouffe, 1985:161).

Rejecting the "class-belongingness" of ideology they come up with a sense of the term which has a higher epistemological profile and broader practical applicability. Now the concept applies also to processes of mystification that arise around other (non-class) social divisions and other forms of social power and domination. For Barrett (1991:167), this definition of ideology also frees the concept from the earlier social structural (usually economic) determinism, opening thus the way for a far more flexible exploration of cultural and subjective phenomena.

For Barrett (1991:80), Althusser, Gramsci and Laclau/Mouffe represent the cracking (or "internal strain") of the Marxist model as in their different ways they recognised and sought to transcend the limitations of the theory. However, the debate over the concept of ideology in theory and its applicability for cultural analysis has not ended with Laclau and Mouffe's post-marxist elaboration of Gramsci. It was continued and cross-fertilised by other "post-structuralist" critiques of the theory of ideology and postmodern discourses. These approaches and influences will be briefly referred to in the following section which is devoted to some non-British approaches to cultural studies.

Other non-British approaches to cultural studies. However seminal the role of British pioneer theorists might have been to date, we have to acknowledge that the field is open to other influences such as those of european structuralism, marxism or postmodernism. There are other important, non-British, tendencies in modern social and cultural theory like the work of Bourdieu and Foucault in France, for instance, the American anthropological tradition Carey (1989:61) identifies with Clifford Geertz and calls "cultural science", the work of M.W. Apple (1982, 1990, 1993) or the work of Giroux (1989, 1992) which is much referred to in this chapter.

Bourdieu. While in the late 1970s relatively crude neo-marxist macro-theory was stressing correspondence and economic reproduction and was offering the dominant discourse available to people interested in analysing the relationship of schools and society, a new version of reproductive theory emerged in the work of Bourdieu. This work was not so much preoccupied with the political economy of schooling and investigated the relationship between economic and cultural reproduction. It employed a less mechanistic concept of culture which is regarded not as neutral but as tacitly preserved in and expected by schools as contributing to inequality outside of these institutions. For Bourdieu, schools operate as powerful agents in the economic and cultural reproduction of class relations in our heavily stratified society; they operate on the basis of the preservation and unequal distribution not only of material economic property but also of symbolic property ("cultural capital", e.g. "good taste", certain kinds of prior knowledge, abilities and language forms). For him, schools recreate the social and economic inequalities of the larger society through a seemingly neutral process of selection and instruction. They take the cultural capital of the middle class as natural (the norm) and employ it as if all children have had equal access to it. Treating, however, children as equal schools favour heavily the children of upper and middle class who possess this certain orientation to the culture of the school and the curriculum, this "cultural capital".

Bourdieu's work on social and cultural reproduction has had a long and remarkable influence in the field. However, while Bourdieu's contribution is widely recognised as pioneering, his model of reproduction has come under substantial critiques which identify certain limitations in his theory, limitations which, arguably, apply to reproduction theories in general. Firstly, Bourdieu's theory espouses a reproduction model of domination rather than conflict. Through this, it provides a rather pessimistic account of social process which renders social transformation untenable and any kind of social struggle futile, reinforcing what Whitty (1985:45) terms the "powerlessness of the working class". Secondly, Bourdieu's theory can be criticised for remaining an essentially class-based theory; thus it ignores other social divisions like the ones of gender and race which should be incorporated in any theory for an adequate understanding of contemporary social relations. For Giroux (1992:152), Bourdieu's work was overdetermined by theories of domination and had no programmatic notion of power in the Foucauldian sense[91].

Foucault. Contemporary post-structuralist critiques of Marxism underline the limitations of traditional Marxist thought on ideology and reformulate ideology in a sense that it may apply to any form of social domination or exploitation rather than restrict it to mystifications related to social class. Post-structuralist theory in general is very critical of the theory of ideology in any form. In fact, "post-structuralist" critiques reject the concept of ideology and commonly develop the concept of "discourse" as the focus of an alternative theoretical model. The work of Foucault has become an exemplar of the "post-structuralist" critique of the theory of ideology. As his work continues to have an enormous cross-disciplinary influence, his key ideas and concepts can provide tools for an alternative understanding of socio-cultural processes. The particular relevance of his ideas to educational contexts and issues are usefully explored by Ball (1990a).

Foucault's approach to discourse and power is a powerful one. For Barrett (1991:161), it draws attention away from overplayed themes and focuses it on to topics of great, but neglected, significance. Questioning the hierarchy of determinism found in marxism, Foucault saw determinism as polymorphous rather than unilinear economic. Developing the general concept of **power** he suggested that the marxist insistence on the dominance of economic considerations tends to systematically exclude other considerations of power. Thus Foucault tended to analyze discourses (medical, legal, sexual and so on) leading to considerations quite other than those of class. Contrary to marxism, Foucault saw power as something that is exercised rather than possessed, as something that is not attached to agents and interests but is incorporated in numerous practices. He also suggested that we can study the "who" of power -who exercises power- only in conjunction with the "how": the strategies, networks, the mechanisms, all those techniques by which "a decision is accepted and by which that decision could not but be taken in the way it was" (Barrett, 1991:136). The object of analysis also changes from power as an absolute, or in itself, to power in terms of power relations.

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APPENDIX FOUR

Visions of computers and Logo as vehicles for social change: the World Computer Centre

At the same time that the Logo group decided the time had come for Logo to become commercially available and widespread in US schools, Logo started being used as part of a large project directed to social engineering. The development of the *Centre Mondial Informatique et Resource Humaine* (World Computer Centre-WCC) in Paris was an attempt to put into practice ideas about larger social change that had been developed around computers. The WCC was an ambitious effort to "put computer power in the hands of the people".

The ideology of the "information society" had begun to penetrate the US society during the 1970s and a romantic computer culture was growing in the States as computers were becoming cheaper. Eloquent visions of an information society were suggesting that computers would become part of people's everyday life allowing for greater leisure time, for equality and happiness, for the shifting of power into the hands of ordinary people who would then have access to information, a former privilege of the military-industrial complex. Within MIT particularly there was an idealistic "computer hacker" culture of people who believed that computers had an extremely important potential as a means for social change. People like Garry Drescher, Margaret Minsky, Danny Hillis and Brian Silverman were talking about computers as potentially a means for democratising society, as a means for greater social justice, for bridging the gulf between rich and poor, for overcoming all kinds of intellectual difficulties for all children, etc.

The French journalist, writer, publisher and politician Jean Jacques Servan Schreiber (JJSS) was probably the most eloquent advocate of the "information society thesis" in Europe. His book "The World Challenge" (1981) was a thesis of stage-skipping for developing countries. His argument was that with the assistance of the technologically advanced countries and the wide use of computers the Third World would skip the stage of industrialisation and move right into the information age. JJSS argued that Third world countries could skip the Industrial Revolution and go directly to the Information Revolution because information technology can be adopted very cheaply and quickly whereas the development of industry needs a huge investment which these countries could not afford.

When the French socialist party won the 1981 election, the idea of giving technology real human meaning was a strong idea resonant with the new government's positions. The excitement about the potential of the "computer revolution" for social change coupled with the new French government's aspirations became the major conditions of possibility for the establishment of The Centre Mondial in Paris which would represent France's contribution to turning this new kind of technology into something socially valuable. The Centre Mondial was established early in 1982 with a lot of publicity, an initial $100m bugdet and a social-political aim: to be a research place for the development of computer systems that would take a larger view of social development, to look into how Informatics could be part of larger social change. It was thought that the place where this could be seen most clearly was in Third World countries. Among the Centre's proposals was a project to install a personal computer in each of 500 villages (most of them in the Third World).

Seventy-five researchers were recruited from all over the world, many of them at enormous scale salaries[92]. Papert wrote the key paper formulating the centre's programme. Brian Harvey worked there and many other members of the Logo community like Hal Abelson and Andy diSessa. Papert and Nicholas Negreponte[93] from MIT took leave of absence from their academic posts to become the co-directors of the Centre. Professor Raj Reddy, former director of the Robotics Institute at Carnegie-Mellon University, was also there. JJSS became the President of the Centre. Papert's vision for the Centre was an idealistic plan for the use of Logo as part of an international computer literacy campaign. The transfer of microcomputer technology that JJSS proposed was to be implemented along the lines Papert had suggested for alternative computer cultures. First, individuals who have used Logo to learn new ways of thinking would band together in local groups to solve common problems. For example, farmers in a small Third World community could use computers to keep better tabs on the availability and distribution of supplies. It was thought that the very act of "exploring" with the computer could engender a flexibility of thought that would in turn allow the farmers to find new ways of combining the efficiency of modern agricultural practices with their traditional cultures. The next step was for communities to widen their knowledge and power bases by linking up, via satellite, with similar communities across a wide region. For example, farming communities could pool their experience about the success of new agricultural techniques so that each farmer need not start from scratch. Finally, networks of communities could become a new social force, with political and economic systems changing accordingly. Within a developing country this might mean that historically disenfranchised groups could gain enough power to demand a more equitable distribution of rights and resources. And in Servan-Schreiber's ultimate vision, the entire Third World would become an electronically linked network of countries ready to co-operate or compete with developed nations.

The researchers employed by the Centre worked on an array of projects. Some were developing new programming languages to make computer systems more flexible and easier for untrained people to use. Others were designing durable and compact microcomputers suited for use in remote areas. One of the most significant projects was the development of an "expert" medical system in Africa to assist rural health workers in diagnosis and treatment of disease. Papert says:

> Automatic diagnosis in a centre like here at MIT where there is a big research group means that the computer is competing with the doctors at the top centres in the world... In the African context, however, this could mean something very different: namely that the people there have never seen a doctor in their lives and have no chance that they will see a doctor in this generation. What they have is sort of very poorly trained people who know very little, hardly enough to be able to recognise ten diseases and give the appropriate treatments. And if you would increase that ten to twenty you could make a substantial difference. So that was one of the themes we were trying to develop. And the other was to develop a close relationship between the Western medicine that was brought in and the traditional medicine. We were working with a couple of very interesting groups of european doctors in Africa who worked closely with the traditional healers. It's all mixed up with magic and animism... But the idea was to try and bring these two together and draw on their positive elements (18).

The medical project in Africa and other projects were in their early stages, loosely organised and minimally defined. They were obviously long-term projects which started having an initial three or four-year research plan to produce some first results. In the meantime, however, the Centre became sensitive to the winds of French politics which signalled its collapse. By a year since the Centre was founded the euphoria that made it possible was beginning to disappear as the new government in France started facing more and more financial and political difficulties and using the Centre for their political advantage:

> The Centre started becoming something that the French Government and ministers who had given money to it and President Mitterrand himself began using for more immediate purposes and they could not afford the long-term perspective that had inspired it. And so the thing started becoming corrupted... And getting the funds was beginning more and more to depend on being willing to co-operate with this sort of thing, short-term political. I think that's really what made it collapse [18].

The French government had promised the Senegalese government a large amount of money as financial aid. Facing financial difficulties at home, however, they chose not to keep their promise. The activities of the Centre Mondial was a substitute that the French decided to offer instead of the immediate financial aid. Thus, during a President Mitterrand's state visit in Senegal- and on JJSS's initiative- the very beginnings of the medical prognosis project were politically presented as something already done that could be shown off. JJSS's advocacy of (French) computers for Third World countries through the Centre Mondial can be seen as an act of neo-colonialism which imposes Western cultural values and definitions of progress and prosperity on other cultures. Moreover, in an interview to Nouvelle Observateur JJSS did not deny his plans to sell French computer equipment to former French colonies. The Third World was seen as a vast market for the French microcomputer industry, at the time largely untouched by American and Japanese firms.

Considering that the direction of the Centre's work had been diverted from its original aims and on grounds of principle, Seymour Papert answered JJSS's interview (which also used racist language) with a sharp letter (calling them racists and scandalists) and announced his resignation in December 1982. Nicholas

Negreponte also left the Centre a few months later and the Centre didn't last for much longer after that. Most researchers of the initial team scattered back to where they came from:

The WCC was to be an international research centre independent of all commercial, political and national interests. Naturally, it failed. Nothing is that independent, especially an organisation backed by a socialist government [what does he really mean here?] and staffed by highly individualistic industry visionaries from around the world. Besides, altruism has a credibility problem in an industry that thrives on intense commercial competition. By the end of the Centre's first year, Papert had quit, so had American experts Nicholas Negreponte and Bob Lawler. It had become a battlefield, scarred by clashes of management style, personality, and political conviction (Paul Tate, *Datamation*).

The French government supported the Centre for a short time with a budget of $13m for 1983 and it restructured its social-sciences staff exchanging staff and expertise with Carnegie-Mellon University in Pittsburgh until it was closed down.

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APPENDIX FIVE

Early classroom-based Logo projects

As already mentioned in Chapter One and Chapter Five, in the first few years of its development -and given the fact that schools didn't have microcomputers- Logo remained a research idea shared among a number of research centres worldwide interested in education. During the same time, a number of school-based research projects were set up and versions of Logo were experimentally tested in a small number of elementary and secondary US schools preparing, in a sense, the ground for the introduction of Logo into more mainstream schools. Early experiments with Logo were carried out by way of "importing" children to the research laboratory rather than by working in real classrooms as in the case of Hanscom School[94]. After 1977, however, Logo was used in a variety of selected research and educational settings.

The Brookline Logo Project[95] started in 1977 as a collaboration between the MIT Logo Group and the public schools of Brookline, Massachusetts, and was funded by the US National Science Foundation. The first phase of the project was based in the Lincoln elementary School in Brookline, Massachusetts, where teaching was carried out by Dr. Daniel Watt, an elementary school teacher who had been working with the Logo Group[96]. Four computers were installed in a computer lab established at the school and all sixth grade students in the school had between 20 and 40 hours of hands-on experience with the computers. The work of 16 out of these 50 students was documented in detail. The study was mainly concerned with finding out: how much Logo programming students could do; how learning Logo might help them with other school work; what other "non-standard" skills children learn (like problem-solving); how learning Logo changes a child's self image; and what changes occur in children's attitudes towards computers. During the second phase of the project, two computers were circulated in two classrooms, one fourth grade and one eighth grade. The children who used the computers did so independently of the teacher and the rest of the class. The teachers in these two classes knew little about Logo and relied on the children to teach each other and draw on the expertise developed by children who had participated in phase one of the project. This activity was identified by the researchers as the creation of the first "Logo culture", as children were exchanging knowledge outside the teacher's domain[97].

The Bank Street College Logo project. The methodology of the MIT Logo Group in both the Brookline and Lamplighter projects was based on qualitative methods, mainly observations, interviews and documentation. No control group was used, nor were behavioural measurements made. The research reports had no strict before-and-after evaluative character and thus failed to provide demonstrable quantitative test results ("hard" evidence) about Logo, something which was at odds with the "hard", quantitative approaches to educational research at the time:

> The Brookline Logo Project was not very successful in obtaining "objective" data about learning gains made by the students. Standardized tests had been rejected as irrelevant to the goals of the project (Watt, 1982:120).

This departure from the mainstream -largely behaviourist- educational research methodology commonly used outside the "Logo community" was bitterly criticised. For example, Pea & Kurland reported that:

> the early reports were primarily descriptive and did not examine closely what the children were actually learning. In addition most were not controlled experiments (Pea & Kurland, 1987:333).

This was the reason that prompted the Bank Street College of Education in Manhattan to set up their own study of Logo in a classroom setting in 1982 and 1983, a study with far less glowing results which was going to create much controversy in Logo research. The study attempted to determine whether students who worked with Logo would demonstrate improvement in problem-solving skills. The general conclusion drawn was that learning experiences with Logo, in and of themselves, did not lead to evidence of transfer to non-Logo activities (see, for example, Pea, 1983; Pea & Kurland, 1984; Pea et al, 1987). Pea (1983:3) considered that while the MIT Logo Group undertook extensive studies of children doing Logo programming, their reports were principally qualitative in nature, citing and discussing some of the programs that were created by the children, the global differences in programming style that seemed to be intuitively distinguishable, and dramatic case studies of great programming progress made by children who had learning difficulties. Pea argued that these MIT reports did not directly address what he thought to be the most important claim which was frequently made for Logo: that it can develop thinking skills that transcend the programming context. He tried to replace "anecdotal" evidence with hard findings, that is to produce

> ...systematic developmental research documenting what children are learning as they learn to program...rather than existing anecdotes (Pea, 1983:1)[98].

The Edinburgh Logo project. Logo was first introduced to British children in 1972 by Cynthia Solomon on a visit as member of a team including Papert that visited Exeter University. In the same year Daniel Bobrow, one of the original BBN researchers and Logo developers, visited the Department of Artificial Intelligence at Edinburgh University as a Fulbright Scholar. A Logo group was established at the Department of AI of Edinburgh under the Head of Department Dr. Jim Howe starting their own Logo project, initially for two years. The project dealt with 11-year-old boys attending a private school near the University (George Herriot School) to determine how children's mathematical skills were affected by programming. The project was highly structured. In the first year the students were taught Logo, and in the second they applied it to mathematical problems within the standard curriculum (Howe & O'Shea, 1979). During the first year the students worked through a set of graded worksheets to learn the basic elements of Logo. In the second year they did special Logo exercises designed to teach topics selected from their regular mathematics curriculum. Researchers could monitor the progress of each student and the students were given standardised tests in mathematics before and after the project. Their progress was compared to that of a control group.

This experiment was the beginning of activity which lasted for ten years and which in the end produced some conclusions which were in sharp conflict with the MIT Logo Group. The Edinburgh Logo Group considered the experiment to be a partial failure and reached the conclusion that children need considerably more help and guidance than the MIT Logo Group considered appropriate. Thus they adopted an approach to Logo to provide such guidance and, more fundamentally, to see if Logo could fit within the existing educational structure. The Edinburgh turn to the assumption that Logo could fit into the usual syllabus was in sharp contrast with the MIT Logo approach: while the MIT Group viewed Logo as a vehicle for "revolutionary" change in educational thought and practice, the Edinburgh Group assumed a more conservative attitude which sought to reconcile Logo with existing methods and materials without fundamentally changing the nature of teaching activity:

> new materials and new methods have to be reconciled with existing materials and existing methods, without fundamentally changing the nature of the teaching activity. Rather than revolutionise education, usually we are only free to reform it (Howe et al, 1980:2).

The Edinburgh Logo project developed rapidly after the first two years of experimentation. In 1974 the project was funded by the Social Research Council. For some time the experimental studies were being conducted within the university and children were being brought in to work with computers. Later the Edinburgh team decided to take Logo out into schools where its effectiveness could be tested in a more "objective" manner. Logo was then experimentally fitted into the existing educational curriculum, something which was in sharp antithesis to the unstructured MIT approach:

> But Edinburgh's attempt to adapt LOGO to work inside existing educational structures was anathema to Papert. He and the MIT team considered that they had discovered something so profound that all existing structures should be thrown away and remade around a LOGO culture. Howe and company thought that not only idealistic and impractical, but wrong. It was a sharp divergence of opinion... (Hammond, 1985:61).

Versions of the Edinburgh approach were finally adopted as the dominant paradigm for the development of Logo-related educational research and policy in Britain in the late 1970s and early 1980s; Logo had to be fitted within the existing curriculum. Analysis in chapters Seven, Eight and Nine explains how the decisions around this rather conservative adoption of Logo in Britain were largely shaped by social and political factors within the broader context of the transition of British education away from "progressive" educational practices[99].

APPENDIX SIX

From Logo to turtling: a chronology of Logo in UK education[100]

- 1980: *Mindstorms* by Papert and *Turtle Geometry* by Abelson & diSessa published. Microcomputer implementations of Logo available in the USA. Edinburgh Logo evaluated in schools in Scotland.

- 1982: Acorn BBC Microcomputer the most popular computer in primary schools. Claims that the in-built structured BBC BASIC obviated the need for Logo. BBC BASIC used to write Turtle programmes.

- 1983: The Advisory Unit for Computers in Education at Hatfield launched DART, a BBC BASIC turtle graphics package based on Edinburgh Logo, as a "stop gap" until a BBC Logo becomes available:

  Logo is a computer language which is far superior to DART. We have tried to incorporate the essential feature of logo graphics into the DART language, **but when real Logo becomes available DART will have outlived its usefulness**.

- 1984: Four implementations of Logo published for the BBC Micro -all on ROM. Logotron's French (*ACT Informatique*) import, based on LCSI Logo, won out, largely because it is on a single ROM chip.

- 1985: Logo chips cost £75. DART is given away free to schools by Government funded advisory centres.

- 1986: Government funded Microelectronics Education Programme publishes *Learning with Logo* report by Beverly Anderson. Turtle Geometry was the focus of this book:

  "On the issue of Logo versus DART... I was impressed with the argument that many **teachers found programmes like DART and ARROW a less intimidating starting point**".

- 1987: *Acorn Computers* "Archimedes" computer introduced with re-compiled 1984 implementation of Logo. The other UK school computer, the *RM Nimbus*, had the 1985 Edinburgh implementation -non standard but with interesting features such as parallel processing. Logo Writer launched in USA.

- 1988: English National Curriculum Proposals (Mathematics) place LOGO in the context of turtle graphics.

- 1989: English National Curriculum Orders (Mathematics) published, replete with references to LOGO. English National Curriculum Proposals (Information Technology) refer to LOGO in same context.

- 1990: English National Curriculum Orders (Information Technology) published with all references to Logo replaced by the phrase "turtle graphics". (It had been discovered that *Longman Logotron* held a monopoly over the supply of Logo implementations for the *Acorn* BBC Microcomputer).

- 1990: A number of educational software houses began to publish "implementations of Logo" that were variations of DART and not Logo, the computer language. The British Logo User Group referred two such implementations to trading standards officers.

- 1993: In March 1993 the response stated:

  "...there seems to be a general acceptance within the trade that the use of **the turtle graphics is equivalent to Logo**".

- 1994: To the existing Acorn RISC-OS Turtle "Logo" packages, Crystall LOGO (Sherston Software) and FirstLOGO (*Longman Logotron*), the Advisory Unit - originators of DART- added AlmostLogo:

  "a sub-set of Logo which handles all of the turtle graphics required by the National Curriculum".

- 1995: A Central Government "command" education system and linked commercial interests led to Logo, the computer language, being displaced by cheap "Turtling" packages. Turtle graphics has become an (educationally questionable) end in itself. DART, in its many re-incarnations, has prospered.

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APPENDIX SEVEN

Between production and consumption: the cultural production of Logo in *Mindstorms*

Seymour Papert is probably the major theoretical exponent of Logo, so much so that he has often been personified as Logo. A former maths teacher involved in teacher training on Logo, and also in policy and curriculum development for a number of years, says about Papert:

> I think he was a better spokesperson. In a way he was like Martin Luther King who wasn't the only one in the Civil Rights movement - a lot of people espoused those beliefs and those ideas and put their bodies on the line but he was the most eloquent spokesperson. And I read *Mindstorms* at least fifty times (23).

The discussion of moment 3 of Logo's circuit in Chapter Seven (marketing and economics) revealed that one clue to the meaning of Logo lies in the study of how it has been represented by players operating outside the context of use. In this context *Mindstorms* has played a paramount role as an intermediary between producers and users. In fact, there was a striking resemblance to some of the features of a religion in the progressivist flavour of the Logo discourse of the late 1970s and early 1980s. First, there was veneration for a good book. *Mindstorms* set out new ideals and standards in a persuasive way. The advice that was given was hard to follow -some said that it was impossible in the real world- yet adherents felt compelled towards following the vision. The 'good book' had an important inspirational function. To those who would have been attempting to conduct their teaching along such lines in any case, a worked-out theoretical rationale gives confidence. To those who have become persuaded by it, it gives the zeal that comes from having seen the true light. In the Logo discourse this effect was hightened by the habit of contrasting progressive, child-centred "Logo-like" activity with bad, old ways which people should reject and repent.

One representational strategy of *Mindstorms* for positioning or "making sense" of Logo: the strategy of marking Logo's *similarity to* and *difference from* existing school classrooms. Considering that prior to, but especially upon its introduction to schools, Logo had to be made attractive to its target-audience, meant that Logo as a product -years after its initial development- had, in a sense, to be re-invented socially. If it was to survive and have an impact in education, it had, over a relatively short period of time, to become an educational necessity, it had to be socially constructed. The rhetoric of *Mindstorms* played a significant role in the achievement of this goal. One rhetorical strategy of the Logo discourse was one of the strategies that I discussed in Chapter Three, namely the extreme caricaturing of existing schools with arguments steadily characterising them as stuck in ever earlier eras and exaggerating their technological backwardness. In fact, many child-centred reformers have sought to make their own proposals more attractive by unfairly caricaturing past and existing mainstream schools and their methods:

> If we were to accept these representations of schooling, it would seem that since the very earliest days of computing in schools, schools have been caught in a kind of time warp, around about 1950 or 1960, desperately in need of transformation and improvement, a transformation that, as it happens, can be conveniently brought about through consumption of enough of the current product range (Bigum et.al., 1993:44)[1].

By exaggerating the degree to which schools were technologically backward and therefore unprepared for whatever unknown demands the world of tomorrow would place on them, the Logo discourse capitalised on parents', teachers' and school administrators' anxiety about the future, in a long-standing advertising tradition of creating a need so it can be filled. Considering that at the same time schools were seen as a potential market, the Logo discourse -unintentionally- added legitimation to the ongoing campaign for "computer literacy" which resulted in the sales of several million microcomputers to US schools alone in the early 1980s. The Logo discourse of the late 1970s and early 1980s became part of the effort to mobilise that market and rouse a historically slow-to-change institution to invest energetically in a new technology.

Blaming the teachers. The extreme caricaturing of schools in the Logo discourse of the early 1980s also reflected enormous intellectual arrogance against teachers who were criticised as largely responsible for the "hopeless" situation of schools.

The hope was expressed that via Logo what its developers saw as the inadequate intellectual preparation of teachers and the imposition of social control by the school would be transcended, and that a lot of children would be assisted to develop their intellectual potential to the full. Alongside a concept of liberation as personal emancipation was an understanding of power which located it as a fixed possession, in this case that of the oppressive, and consequently repressive, teacher. Personal liberty of children became synonymous with the lifting of that repression. The critical attitude towards teachers changed over the years as Logo's developers worked more and more with teachers in the "evolution rather than revolution" manner mentioned in Chapter Five. In fact, Papert's *The Children's Machine* (1993, especially chapter 4) provides the necessary corrective. However, the negative stereotype conveyed in the Logo discourse of the late 1970s and early 1980s has in many cases annoyed teachers who argued that the developers of Logo ignored some of the realities of mainstream schools and classrooms. In this sense, the extent to which the pedagogy argued for in the Logo discourse is "non-traditional" is questionable as this pedagogy was clearly *traditional* in "progressive" education, elements of which were evidently present in many classrooms in the late 1970s.

This lack of attention to -or the exaggeration of the backwardness of- the pedagogical context of Logo's use, resulted in a decontextualised -assumed rather than discovered- account of this context, offering little -if at all- analysis of the institutional and structural conditions of mainstream schools. In fact, the Logo discourse and its developers tended to assume a context of use which was somewhat at variance with the context of use into which Logo was inserted. I have shown elsewhere that Seymour Papert had assumed an extreme de-schooling position based on a "we are the radicals, schools are reactionary" polarity. However, at the point that Logo was introduced into schools this was not exactly the case, as a lot of progressive education ideas and practice were in place, especially in primary education, and there was a number of schools which clearly did not fall into Papert's stereotype of absolute conservatism (see Cuban, 1993). An implication of this discrepancy is the hypothesis that having not taken quite such an extreme position, the developers of Logo might have thought more carefully about ways of introducing it into schools.

This inconsistency also created confusion and -in some cases- suspicion or even anger among teachers (who were the major target-group of the Logo discourse), especially among "progressive" teachers. For example, a former maths teacher and leading Logo enthusiast involved in teacher education and curriculum development for the last fifteen years, argues that the Logo discourse in *Mindstorms* reinvented the wheel:

> I think he [Papert] was hardly aware of the education culture. In his speaking I used to be very irritated at him... because he sounded like he hadn't been in school for 25 years! Because the picture he was giving of what kids would do he could have seen if he had just walked around the corner, and in my classroom, and into that classroom, and into the other classroom... so I would get very angry, I don't think his ideas were radical (28).

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APPENDIX EIGHT

The pendulum swing

As already mentioned in Chapter One, in the early 1980s Logo was no longer a marginal, private experiment; through the pioneering school-based Logo projects which I mentioned in Chapter Five and in Appendix Five, Logo had caught the imagination of a large number of teachers. Following the introduction of microcomputers in education, it became available to a large number of US and British classrooms. A community of excited teachers emerged within which high expectations and enthusiasm arose about what was seen as the potential of Logo as a vehicle for educational change. The excitement was significantly greater in the US where, in many cases, Logo advocacy became synonymous with messianic zeal as many early Logo enthusiasts saw it as a panacea for the ills of an educational system in crisis. A large number of (mainly elementary) school teachers were said to have "caught the Turtle Fever". A 1982 American report reads:

> This report provides recent news from Logo projects and classes around the United States and Canada. Far from assessing the status of Logo in American and Canadian education, the report merely hopes to capture something of the character and spirit of the people who are teaching Logo or guiding Logo projects. Logo projects and programs exist from coast to coast: from the Microcomputer Resource Centre at Teachers College at Columbia University in New York, to the Marin Computer Centre in Corte Madera, California. Telephone calls to participants in many Logo activities invariably found people enthusiastic about Logo and its future. It was seldom necessary to ask questions after saying something like, "Tell me what you are doing with Logo". Explanations and anecdotes came pouring out (Lemmons, 1982:334).

After a while, however, the excitement started to wear off. The initial atmosphere of extremism gave way to a more cautious advocacy. Limitations and inappropriate uses were found while controversial research evidence was being cumulatively reported from experimental studies. The great expectations of professional people from Logo did not seem to be realised. Many of those who had believed the early extravagant claims about the radical potential of Logo felt disillusioned. Since the mid-1980s there has been an increasingly more pervasive backlash against Logo -especially evident in the States- where Logo has been in a sense denounced as having "failed to deliver what it promised":

There was a big pendulum swing, particularly in the US, against Logo, as a reaction. Something else has come along, in terms of hypermedia and new software, it didn't involve programming... People were disappointed from Logo. They had the expectation that suddenly their world would be transformed by using Logo, and then when it wasn't, instead of debugging their expectations they said 'throw it away, it didn't work., try some of the next miracle'. I think people had the expectations to do this and suddenly the world to change (11).

The early days of a new thing is always a time for great enthusiasm and vision. I think that there were some people who saw that their expectations weren't lived up to, that this type of change that they were hoping for was more difficult to bring about than what they had hoped. I think initially there was probably some optimism that wasn't fully grounded and over time people saw how difficult it was to bring about change (20).

A number of positions have emerged in the literature as candidates in the quest to explain the pendulum swing against Logo in the 1980s (e.g. Clements, 1985; Michayluk, 1986; Maddux, 1992). Most of these accounts have little -if at all- explanatory power as they assume a functionalist orientation and discuss the introduction of Logo as a matter of implementation[1]. In so doing, such accounts fail to shed light in deeper structural relations underpinning the introduction of Logo as an educational innovation and remain of limited value.

In addition to the explanations found in the literature, a number of more useful accounts can be found in the research data collected for this study. For example, two former members of the MIT Logo Group suggest that the "decline" of Logo can be partly attributed to economics:

But the great push which I think was an economic push and a short of revivalist push, the real momentum in this thing was already gone. Computers were in the schools, computer companies had decided that Logo was not a programming language to use for selling more computers (8).

A leading computer scientist of the MIT Logo group provides a different interpretation arguing that the second half of the 1980s was a time when lots of other things were being developed for computers whereas in the early 1980s Logo was one of the dominant uses of computers in schools:

So if you look at the percentage of computer use at schools dedicated to Logo, that clearly dropped very rapidly in the 1980s. If you looked at the number of hours of Logo usage my sense is that it continued to grow but as a much smaller piece of the bigger pie. Because they were so many other things that were being done now with computers. So it was no longer a dominating influence. In the early 1980s Logo had always set the agenda for what people talked about both within educational circles and educational research circles, Logo really influenced what people were talking about. It became less of a central voice in those discussions as time wore on because there were many more voices that were introduced (20).

A synthesis of the previous two positions is provided by another key-figure in the development of Logo who argues that the subsequent rise of pre-packaged software of various kinds for schools is responsible for the pendulum swing against Logo:

So the battle nowadays -it used to be which programming language are you using, should you program in Logo or BASIC or Pascal or C or whatever- nowadays the argument is 'should kids program at all?', we are back to that. Cause now you see 'there's all this wonderful software that you can use and why should anyone write their own?'... And not only is that argument with teachers, it is also with kids... Their standard of computer programs are computer games. So you start up Logo and here is the screen and nothing is happening. And nothing is going to happen until you do some work. And that's a hard sell these days (10).

A fourth interpretation is provided by Seymour Papert who sees the 'normalisation" of Logo mainly as a reaction of the organisational culture of schools:

At the middle of the 1980s you saw a big change. Because in various ways the school administrations took over and sort of 'normalised' this. And I think it's like an immune reaction. In the period starting about mid-1980s until the early 1990s (although there were still a lot of visionary teachers) the dominant use of the computer was becoming this administration-controlled use, more to bolster the status-quo than to undermine it (18).

Although more useful than most of the explanations provided in the Logo literature, these -even if taken together- still leave us with an unclear picture, let alone a sociological picture. This study is committed to providing a more sophisticated account of the mechanisms at play. Because the introduction of Logo in schools has been a more complex phenomenon than these partial accounts take it to be, in a sense that it has been located within a changing social, political and ideological context. To get the larger picture, therefore, it is necessary to address the introduction of Logo into schools as a series of conflicts and struggles over the meaning and control of education and the curriculum at least at three different -yet interrelated- levels: the social-political, the organisational and the pedagogical.

APPENDIX NINE

Epistemological politics in the evolution of Logo

The struggle over the meaning of Logo was not confined within the walls of BBN or MIT. Rather, in the late 1970s and (especially) during the 1980s, it involved a growing number of individuals and groups outside the initial research teams. Beyond the controversy created during the development of early school-based Logo projects (mentioned in Appendix Five), serious tensions as to what Logo is and what it should be arose within the ranks of researchers upon Logo's introduction to mainstream schools in the early 1980s as a vehicle for learning with and about the then-newly available microcomputers. The confusion surrounding the nature of Logo and programming (see, for example, Moursund, 1983; Tetenbaum & Mulkeen, 1984) was not confined to teachers and schools. Far from it: some of the most revealing confusion has come from within the ranks of researchers[101]. How and why did this happen?

At the time that Logo was introduced into mainstream schools, the claims of *Mindstorms* (some of them presented in Chapter One) were unsupported by traditional experimental research; they depended on qualitative descriptive data and were presented as a vision. This lack of "hard" evidence triggered an explosion of experimental studies which aspired to test some of Papert's assertions. At a time of forceful debate over the "educational" value of computer programming as a mathematical activity, a large number of Logo-based studies set out to measure what students gained from "learning Logo", with mixed results (see Clements, 1985, 1992). By 1985 the amount of printed material about Logo had skyrocketed:

> It is, perhaps, somewhat unfortunate that the wide availability of Logo in the early eighties coincided with a massive wave of enthusiasm for "problem solving" as the latest panacea for mathematical learning. It was unfortunate because it gave vent to a surprisingly large number of studies which were inconclusive and/or methodologically suspect (Noss & Hoyles, 1996:166-67).

The idea that learning to program a computer using Logo leads to a development of other mental skills was the suggestion being at the centre of the debate over Logo and the bulk of Logo studies have been conducted to determine if learning to program in Logo has a positive effect on other aspects of thinking. Results of this research are mixed[102]. As Appendix Three indicates, the results of the Manhattan's *Bank Street College* Logo project contradicted heavily the MIT Logo team approach based on an entirely different set of assumptions. Until today issues regarding the evaluation of Logo's role in education are still far from settled. However, it has not only been research results of testing these claims that were conflicting; the 1980s were also marked by a more fundamental conflict as to what constitutes appropriate research and evaluation on Logo as the following quotation from Papert's speech at the BLUG Conference (Loughborough, 1983) indicates:

> I would like to discuss the Bank Street report, not because I disagree with the findings, but because I think that the methodology used, which is standard in educational psychology, might not be pertinent to get at the heart of what is going on in the process of learning Logo.

The conservative positivism of the bulk of Logo research studies in the 1980s has been well documented in the literature:

> ...an unspoken assumption among researchers conducting many experimental or quasi-experimental studies that Logo was some kind of "treatment" for which effects could be measured (Watt & Watt, 1993:63).

> The research community made its own meanings for Pea & Kurland's work, in terms of an already fading but still entrenched paradigm of transfer and a methodology more suited to agriculture than education (Noss & Hoyles, 1996:180).

The conflict over Pea & Kurland's study was only the tip of the iceberg. As I have already illustrated in the discussion of the NSF funding cuts earlier in Chapter Five, the issue of the validity of standardised testing methodology for the evaluation of Logo-based activities goes back to the 1970s and reflects the deep epistemological conflict between the developers of Logo and the dominant culture of traditional mathematics education and educational psychology. Deeply embedded within a positivist paradigm reinforced by ahistorical and desocialised assumptions of cognitive psychology, the majority of Logo studies set out to measure children like plants and examine the "effects" of Logo programming on them. Neglecting the complex interaction between the socio-cultural context and learning, they viewed Logo as a package treatment for which “effects” can be measured. By focusing on external measures of hypothetically generalisable skills, they displayed, one after the other, a depressing trend towards rediscovering behaviourism. There was a deep technological determinism embedded in many such Logo research studies, in a sense of the term as discussed in Chapter Two. Reaching sometimes the opposite extreme of social determinism, Papert attacked this kind of research calling it “technocentric thinking”. Defending the qualitative methodology of the Logo Group, he suggested that any attempt to find "the effect" of Logo is misguided:

This [technocentric] tendency shows up in questions like "what is THE effect of THE computer on cognitive development?" or "does Logo work?" ... However, such turns of phrase often betray a tendency to think of "computers" and of "Logo" as agents that act directly on thinking and learning; they betray a tendency to reduce what are really the most important components of educational situations -people and cultures- to a secondary, facilitating role. The context for human development is always a culture, never an isolated technology. In the presence of computers, cultures might change and with them people's ways of learning and thinking. But if you want to understand (or influence) the change, you have to centre your attention on the culture...not on the computer (Papert, 1985:54).

The technocentric ideology underlying the bulk of Logo studies was also supported by the dominant model of what a "rigorous" experiment in educational psychology consisted of; Papert called this the "treatment model":

You take two groups of children. One group, the experimental group, is given a certain "treatment". (For example, these students are taught Logo.) The other group, the control group, is not given the treatment. Everything else is kept constant. After a suitable lapse of time you come back and apply a test to see whether the particular thinking skill that interests you is better developed in the experimental group than in the control group...it is the standard model for testing medical treatment by drugs (Papert, 1985:56).

As the preoccupation with testing and results was at the heart of the conservative restorational politics already well underway in US education in the early 1980s, the “treatment” paradigm fitted well in this dominant social and political context[103]. Dan Watt recalls:

What it means to “have had Logo” was never investigated in those studies... I absolutely despise that research! It’s poorly conceived and poorly carried out research but very politically used by people who either to save out money or to move to another kind of use of the computer or whatever... used it politically to discredit Logo (7).

In terms of the cultural circuit, the response of a conservative research community which re-constructed *Logo* as a "treatment" was a powerful "reading" which fed back seriously into the first moment of "production"; in fact, there is a complete re-birth of moment 1 in this rather conservative construction of Logo as one can see, for example, in the case of the Edinburgh Logo Project and the spread of Logo in Britain (see Appendix Five).

Notes

CHAPTER ONE

[1] See Appendix Two for a list of the major UK IT in education initiatives between 1980 and 1996.

[2] **The social rationale** focuses on the desirability of fitting pupils to the demands and needs of the wider society. The argument simplified here is that since schools largely prepare children for life, they should prepare them to deal with computers which should be de-mystified. As computers recently permeate every domain of human activity in industrial or "developed" societies, children should be aware and unafraid of how computers work in order to function effectively in the coming "information society". Knowledge of/about computers is regarded as necessary as literacy and numeracy. The argument rests more on a kind of technological determinist fatalism, which suggests that computers are going to be 'everywhere' in the future - from banks to grocery stores to TV sets to cars -and that, whether students will need computer skills in their work or not, they need to have some knowledge about computers;

the pedagogical rationale is quite different; here, computers are seen as relevant to education because they seem to enable pupils to learn and teachers to teach differently (better) than they would without them. It is argued that subject teaching as well as cross-curricular work can be improved with the use of microcomputers and appropriate software; computer programming has also at times been regarded as a useful activity, especially in terms of assisting the development of children's capacity for formal expression of mathematical ideas;

the vocational rationale, which is more specifically concerned with preparing pupils for the needs of the external job market. While the *pedagogical* rationale stresses the needs, interests and (mainly cognitive) development of the learner, the *vocational* tradition stresses the occupational destinations and needs of the learner. The reasoning here is that general knowledge about computers, practical operational skills of at least a basic level, some programming, use of application programs, etc. provide children with confidence in their ability to control computers and with additional useful skills required by the job market. In this tradition, knowledge is chosen for its value in the preparation of a skilled workforce, and in aiding learners to develop the knowledge and skills which will maximise their potential in future work. Although computer-literacy justifications have regularly appealed to all the six rationales presented here, in their most common form they are essentially *vocational* arguments. They assert that computers will dominate the workplace of the future, and that students must therefore have some knowledge of how computers function, in order to be comfortable and competent in such a workplace;

a more radical **catalytic rationale**, which is premised on the view that computers can usefully transform schools for the better. Teaching, administrative and managerial efficiency may be improved. Computers, it is argued, will reduce the stress on memorization and individualisation in favour of information handling, problem solving and collaborative learning. They will also extent educational opportunities to a larger number of children;

the information technology industry rationale, backed by the industry itself, argues that the placement of large numbers of "home" made computers in schools will vitalise the local industry at times of hard international competition and also reduce the cost of hardware. For Hawkridge (1991:28), this rationale is without doubt market-driven, under the guise of serving the national interest.

the cost-effectiveness rationale which has little support. It is argued here that computer hardware and software could in several cases replace teachers, and be more cost-effective. For Hawkridge (1991:28), some supporters of this rationale possibly draw their evidence from industrial and commercial training, where computers are cost-effective in certain settings. Others suggest that, in real terms, prices of computers are falling, whereas salaries of teachers are rising. Yet, they have no hard evidence to support their rationale, because no cost-effectiveness studies have been done.

[3] See, for example, the following documents:

EUROPEAN COMMISSION, *Report of the Task Force "Educational Software and Multimedia"*, July 1996. The report as well as other recent information concerning the "Educational Software and Multimedia" Task Force can be found on the World Wide Web address: http: //www.echo.lu.

COUNCIL OF THE EUROPEAN UNION, resolution 6666/96 relating to educational multimedia software in the fields of education and training, 2 May 1996.

EUROPEAN COMMUNITIES (1997).

[4] The term has been introduced by Beynon & Mackay (1989) and will be explained in Chapter Three.

[5] For example, see Beynon & Mackay (1989), Robins & Webster (1989); Noble (1991); Young, (1984, 1991); Matthews (1991, 1992), Bigum & Green (1992); Muffoletto & Nelson-Knupfer (1993); Apple (1993), Bromley (1995).

[6] The notion of "technological determinism" will be discussed in Chapter Two, where a distinction will be drawn between technological determinism and the sociology of technology.

[7] A constructivist view of learning holds that learners actively construct their own knowledge when they engage in experiences which allow them to build upon prior knowledge, confront discrepancies between that knowledge and their experiences, and reformulate their understandings to account for new circumstances.

[8] Essential to the philosophy of Logo's development was the assumption that children would have access to personal computers that could support a powerful programming language. The development group made a language that needed such machines at a time when small, powerful and inexpensive machines did not yet exist. Another effort with a similar philosophy (design a powerful language and assume that the hardware will be there to support it when the time comes) was pursued by Alan Kay and his research group at the Xerox Palo Alto Research Laboratories. Although it was never commercially distributed, their language, Smalltalk, was used in experiments of teaching children to program. See Kay & Goldberg (1972).

[9] I will demonstrate in chapters Five through Nine that a number of compromises were made in terms of Logo-the-language in the early stages of its development (that is before Logo was introduced into mainstream schools) as well as during the phase of marketing, which meant that some of the claims that Seymour Papert was making for it were less easy to realise. As I will show, by the time that Logo reached mainstream schools, it was no longer permeated by the same degree of radicalism for departure from traditional school patterns which characterised its earlier years.

[10] With few exceptions (e.g. Lawler, 1987; Noble, 1991), the early history of Logo's development at BBN and the move of Logo research from BBN to MIT have been largely ignored and excluded from the Logo literature.

[11] For a review of these approaches see Solomon (1986) and Bromley (1992).

[12] Chapter Six will provide an analysis of "Logo as text".

[13] Claiming its continued intellectual currency, the second edition of *Mindstorms* was published in 1993 alongside Seymour Papert's new book *The Children's Machine*.

[14] Chapter Five will show that there were "strands" within the team of people who developed Logo in the early days.

[15] The "turtle" is a small cybernetic animal, which was introduced in order to concretise abstract ideas of computer programming. It exists in two forms: a. as a screen turtle and b. as a robot (floor turtle). It is based on the principle of "body syntonicity", that is, the idea that the learner identifies spatially with the turtle which is able to move physically according to the commands given to it by the programmer. Its name ("turtle") was derived from Grey Walter's cybernetic invention, the tortoise. The first floor turtle was produced in 1970, looking very much like a big yellow cannister-type vacuum cleaner on large wheels with a pen in the middle of its belly. The floor turtle was followed quickly by a screen (graphics) turtle. Turtles crawl around leaving a trace of their path, or not, as the programmer wishes. They can be used to construct objects. These objects can then be used to create new objects. In some implementations of Logo and turtle graphics, several turtles can exist at the same time.

The idea of "body syntonicity" will be explained further in Chapter Six.

[16] As an extension of Chapter Three, Appendix One will look into the 1980s' IT-in-education initiatives and policy, providing a discussion of the context within which the introduction of Logo into US and UK mainstream schools took place in the early 1980s.

CHAPTER TWO

[17] See, for example, SHAW, E., "Media Images of Computers", in Salvas (1986) for such images in the 1980s.

[18] Among the names of those involved in this particular school of thought are a number of Europeans and Americans: H.M. Collins, Trevor Pinch, Wiebe Bijker, Donald Mackenzie, Steve Woolgar, Bruno Latour, Michael Callon, Thomas Hughes and John Law.

[19] Social constructivism is by no means an entirely unified viewpoint. There are some important differences among its leading practitioners.

[20] For example, Hughes (1985) illustrates through a historical study how the invention and the particular design of electric light-bulbs by Edison was not a "matter of a sudden flash of inspiration from which [the] new device emerged ready made" but was largely a successful combination and modification of existing technologies determined by strict economic reasoning and considerations of commercial competitiveness with the existing gas system. He shows that technological decisions were also economic decisions and that the search for the cost-saving component was the vital issue leading to the particular final design of the light-bulb which allowed for reduced amount of copper (a costly material) to be used for conductors of electric currents.

[21] The term was initially coined by Winner (1986:105).

[22] In Somekh's story, the power of the picture depends upon the viewer's interpretation of its cultural meaning:

Larger than A4 size, it is made of a double sheet of card, in such a way that its pop-out folds enable it to stand alone. The brightly coloured collage displays a computer (centre foreground), a dinosaur running, a male high-jumper in flight, a violin, a praying figure from a stained glass window (male), President Kennedy, text from the New Testament ('Spirit is truth'), a space rocket on the launchpad, etc. The backdrop is of the world photographed from space, as if controlled by me, owner of this computer and its wondrous software. Across the picture, from top to bottom is written:

one small step for man
MULTIMEDIA
one giant leap for mankind (see pictures on the next page)

The word 'giant' appears on the computer screen and the word 'mankind' on the keyboard. Despite the gender bias of the material, I am stirred. Neil Armstrong's famous words, as he stepped on the moon, strike a chord of adventure and achievement. The dream of transcending mortality, 'reaching for the moon', is compelling. It reminds me of the excitement I felt the first time I realised it was possible to communicate with teachers and children in America, and round the world, direct from my own computer. The writers of the RM's advertising copy knew they could rely on me to construct the full text of the message they wanted to convey. The idea of multimedia is exciting, making me feel that new kinds of knowing and new ways of working are possible. Is my response so different from that of a Tibetan Buddhist viewing a holy picture of Buddha enthroned, surrounded by 'auspicious symbols, syllables and deities...for attracting good luck, wealth, long life, happiness, wisdom and spirituality?'" (Somekh, 1993:1)

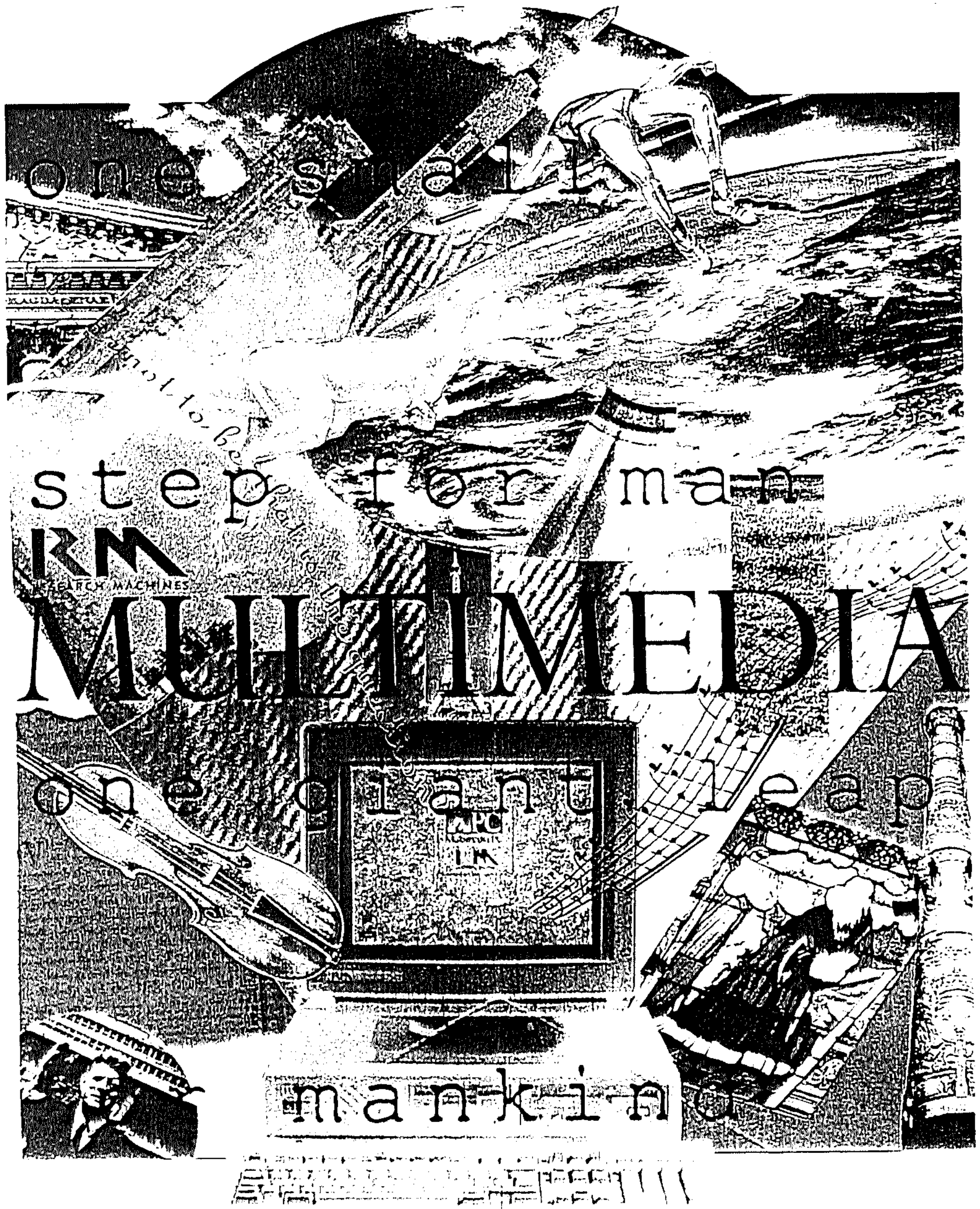


FIG. 1. Buddhist prayer charm of auspicious symbols, syllables and deities, for printing on paper or on cloth flags, to be openly displayed for attracting good luck, wealth, long life, happiness, wisdom and spirituality. At the center is a stupa (tower shrine) with the Buddha, and, above him, the merciful Bodhisattva Avalokiteshwara. At top center is Amitayus, the Buddha of Boundless Life, with Manjushri, the Bodhisattva of Wisdom, at the left and the Protector Vajrapani to the right. The complex monogram of ten seed syllables below Manjushri represents mystic integration; the book and flaming sword below Vajrapani symbolize wisdom. At the bottom are shown auspicious animals, birds, fruit, emblems, jewels and an old man in obvious comfort. A disciple prays at the stupa. Woodblock from Thangboche monastery, Solo Kumbu, N.E. Nepal, 30.4 × 46.8 cm.

[23] See, for example, SHAW, E., "Media Images of Computers", in Salvas (1986) for such images in the 1980s.

[24] According to Mackenzie & Wajcman (1985:2), in most current discourses technology is described as an autonomous factor which influences society in certain ways; it is the dominant approach that technological change has "effects" or "impact" on society. Technology is viewed in a heavily technological determinist way as an independent factor which influences society from outside and as the cause of social changes. Mackenzie & Wajcman suggest that the notion of technological determinism should not remain unexamined and unchallenged. For them, the notion of technology having straightforward social "effects" is altogether too simple since it is also the kind of society that we live in that affects (shapes) the kind of technology that is produced. Therefore, the question of the effect of a particular technology on society is one of the most difficult questions to answer, one which requires an understanding of the broader dynamics of a society. In contrast with the notion of an "autonomous" technological change, Mackenzie & Wajcman (1985:2) are concerned with the alternative question of what shapes the technology in the first place and, particularly, what role society plays in shaping technology. For them, technological artefacts should not be taken as given or as inherently neutral devices. Technologies are designed by particular people with particular interests and for particular purposes in a particular society and, therefore, there are always certain sets of considerations and choices (e.g. economic) that influence or even determine their design. Thus, contributors to the volume tend to view technologies as embodying -consciously or unconsciously- properties which "open certain social options and close others". They argue that it is naive to view technical artefacts as neutral "autonomous" things (which develop independently and which only have social "impacts") and thus fail to look behind technical things to notice the social circumstances of their development, design, deployment and use. They suggest, therefore, that technologies should be projected in the context of their shaping by social and economic forces and be viewed as deeply caught up in technological politics. Mackenzie & Wajcman (1985:7) identify two ways in which technological artefacts can contain political properties:

- first, there are instances in which the invention, design or arrangement of a specific technical device or system becomes a way of settling an issue in a particular community;

- second, there are instances where some technologies are by their very nature political in a specific way (inherently political technologies), instances in which technologies appear to require, or to be strongly compatible with, particular kinds of political relationships.

An example of the first case is the design of the low-hanging overpasses on Long Island, New York, which were deliberately designed by Robert Moses to achieve a particular social effect: to prevent poor people and blacks (who used public transport) from using the parkways for recreation and commuting as the tall buses could not get through the low bridges; a particular intentional design expressive of social class bias and racial prejudice, an obvious way in which technology was used consciously to enhance the power, authority and privilege of some over others. An example of the second case is the atomic bomb (nuclear weapons in general) which require a centralised authoritarian system of social relationships.

[25] This UK's national initiative was inspired by debate within the UK and abroad about the long-term social and economic implications of developments in information and communication technologies. The programme, which has involved six university research centres making up the PICT network, has supported a variety of research projects focused on the examination of the complex interrelationships between the economic, social, managerial and policy issues raised by the development of information and communication technologies; on the ways in which public policy and other factors have shaped the design and diffusion of new technologies; the use of these new technologies in settings ranging from the household to emerging information service industries; and the role played by electronic media in our work, travel, education and entertainment (it is really very hard to avoid using technological determinist language). The theory and research of the programme covered the following general areas of inquiry:

- Living in an Information Society, including competing conceptions of the information society and critical perspectives on social and economic issues related to ICTs in the household and among the public at large as users, consumers, citizens, viewers and audiences;

- ICT Development and Innovation, including factors shaping their design and development, technology transfer, technological initiatives, and the sociology and management of software engineering;

- ICTs in Organisations, focusing on IT management and strategy, productivity, management control, the politics of IT, new organisational forms, employment and the workplace, including the allocation of work between different locations, and IT adoption, design and implementation;

- Communication Industries and Public Policy, including industry strategy, market forces, industrial reorganisation, policy and regulation, telecommunications, broadcasting, cable, satellite, online services, and other new electronic media, including the changing communication infrastructures of cities, regions and nations; and

- Issues in the Study of ICTs in the Social Sciences, including work on science and technology studies, the social dimensions of technical change, the role of audiences in shaping social research, and the cultures of producers and users of social research.

[26] For example, see the following two speeches to the PICT Conference, which the author attended:

PADDY ASHDOWN, MP (Leader of the Liberal Democrats), *"Learning and Education: the role of new technology"*, Speech to the PICT Conference, Thursday 11 May 1995, Queen Elizabeth II Conference Centre, Westminster, London.

KENNETH BAKER, (Conservative Party), *"Powering Vehicles on the Information Superhighway"*, Speech to the PICT Conference, Thursday 11 May 1995, Queen Elizabeth II Conference Centre, Westminster, London.

It is also interesting to see Tony Benn's (Labour) speech *"Information and Society"*, delivered at the RESOURCE Conference (Doncaster, 24.11.95) only a few days after the PICT conference. The texts of the three speeches offer valuable material for analysis.

[27] The Evaluation Development and Review Unit of the London-based Tavistock Institute. The evaluation report of PICT is expected at the end of 1997.

[28] A brief account of the evolution of cultural studies can be found in Appendix Three.

[29] See, for example, duGay, et.al. (1997), chapter six.

[30] Drawing on Hall's work (1986), Moores argues that there is nothing inevitable about the coupling together of discoursive elements and this also applies to the embedding of media technologies. We cannot predict simply from the development of a new means of broadcasting, how it will eventually come to have significance for audience groupings. It is certainly the case, he argues, that designers and advertisers play an important part in encoding the object prior to consumption. Programming policies are also formulated with specific viewing publics and market segments in mind. However, the linkages made with such local settings demand detailed empirical investigation. Moores' commitment, therefore, has been to qualitative research carried out at homes in selected neighbourhoods where satellite dishes have recently been installed. By talking to family members about their newly- acquired commodities, and by observing the

domestic and residential environments, he believes it is possible to construct suitably "thick" descriptions of situated consumer activity.

CHAPTER THREE

[31] The details of the evolution of educational computing policy in the US and the UK are interesting but not crucial to the argument that I am presenting in this thesis. Readers interested may find a narrative of this policy put into context in Appendix One. Also, a chronology of IT in education policy for England and Wales (between 1980-1996) can be found in Appendix Two.

[32] Noble (1984), Street (1987), Rassool (1992) and Mackay (1992) have explored the notion of "computer literacy" as a category of literacy. Discussing the emergence and growth of "computer literacy" and the various ways of implementing it in schools, Mackay (1992) draws parallels between "computer literacy" and literacy as conventionally discussed drawing largely on Street (1987), Levine (1986); Graff (1979) and Freire (1972). Mackay (1992:135) argues that 'computer literacy' is an ideological concept which enjoys the appeal and credibility it has because it engages successfully with elements of particular dominant and popular discourses. First, it draws on the fear of the uninitiated that they will be left behind by the "computer revolution" in a perceived movement towards a post-industrial or "information society". Second, it draws on the psychological fear or distaste for interacting with computers which some people have (Turkle, 1984). Third, on the political argument that technologists must be accountable to the public and the demand that the public should therefore technologically literate. Fourth, on the argument that the development of commerce and industry needs high level of skill on the part of employees who will be individually responsible for possible lack of appropriate skills and will suffer unemployment. For Mackay (1992:138), "computer literacy" is clearly congruent with the interests of particular parties which include manufacturers of hardware and software who are trying to enter the educational market as well as those working in education whose careers are tied in with the growing demand for INSET in the area. Mackay argues that technicist computer literacy is the contemporary equivalent of functional literacy campaigns of the past, "a little reading and a little writing" which -by focusing on the technical- have not in any way empowered the citizenry: "it can at the most lead to a false sense of power and control". Mackay maintains that the emphasis should not be on mere artefacts, but on how these relate to social processes; that the key to computer literacy, or technology literacy, lies in understanding the social nature of technology.

[33] See Stronach (1989); Robins & Webster (1989); Goodson & Mangan (1993).

[34] BROMLEY, H., "Culture, Power, and Educational Computing" in BIGUM, C. & GREEN ,B. (eds), *Understanding the New Information Technologies in Education: a resource for teachers*, Centre for Studies in Information Technologies and Education, Deakin University, Geelong, 1992.

[35] For a review of Schofield (1995), see Bell (1996).

[36] See, for example, Apple (1993, chapter 5). Also, school children-as-audience research by Buckingham (1993a, 1993b, 1994) has pointed to the centrality of focusing on the "consumption" of various media and communications as "texts" through a cultural studies perspective. Focusing mainly on the powerful and pervasive character of TV and all the cultural products and practices that go with it, Buckingham maintains that they can neither be treated with disdain nor ignored by schooling, but must be treated as social text, cultural icon and sociocultural practice with significant political implications at the levels of global and local experience.

[37] In fact, serious interdisciplinary educational research on media and pedagogy goes back at least as 1986 when Hodge & Tripp (1986), drawing on developments in audience studies, argued that educational research on media and pedagogy must realise that semiotics, psychology and social and political theory, are inseparable aspects of the methodology that must be employed in understanding the relation among media, education and power. Hodge and Tripp attempted to construct such a methodology by combining semiotics, psychology and ethnography.

[38] A number of other studies can be classiffied as belonging to the same tradition, for example, Ellsworth (1989), Luke & Roe (1993), Turnbull & Moss (1993). Given, however, that the discussion of media studies in education is not a central focus for this thesis, for reasons of brevity and coherence I have chosen not to include a longer discussion of these studies here although I had developed a review in an previous draft. Readers interested in the area may find an interesting (although biased towards postmodernism) discussion in the Special Issue on Media and Popular Cultural Studies in the Classroom, *Australian Journal of Education*, Vol. 37, No 2, August 1993.

[39] JOHNSON, R., "What is Cultural Studies Anyway?", stencilled occasional paper No 74, Centre for Contemporary Cultural Studies, University of Birmingham, 1983. A shortened and extensively revised version of this paper is the following: JOHNSON, R., "The Story so Far: and further transformations", in PUNTER, D. (ed), Introduction to Contemporary Cultural Studies, Longman, 1986.

For a brief history of the evolution of cultural studies see Appendix Three. Also, the following sources reflect the struggle to define and redefine cultural studies: Brantlinger (1990), Clarke (1991), Grossberg (1992), Turner (1990). For a fuller reappraisal of the entire array of competing approaches to cultural studies from the original Marxist theories of culture critique to contemporary feminist and poststructuralist readings of popular culture, see Agger (1992). Chapter 5 of that book also provides a valuable discussion of the Birmingham CCCS' approach.

[40] Haddon, L., "The Cultural Production and Consumption of IT", in Mackay, Young and Beynon (eds), *Understanding Technology in Education*, Falmer, 1991.

[41] However, Johnson (1986:302) warns us against bourgeois ethnographic accounts that pathologise subordinated cultures and also against accounts that treat cultures as homogeneous and distinct ignoring internal divisions like the ones along the fractures of race and gender.

[42] Hebdige (1988) takes up Johnson's reconstruction of the cultural significance of the Metro across the four moments and supports Johnson's argument that if we are to produce a comprehensive analysis of the cultural significance of an artefact we would have to take into account the kinds of significance generated as the object "passes" through a maze of independent but interlocking frames (moments) -drawing back at every point to consider the structures in which each individual frame is housed:

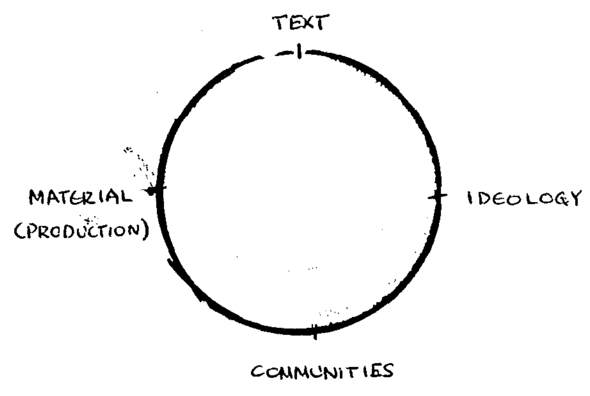
> ...the meaning of the Mini Metro is overdetermined by the uncertainty surrounding its production and the reputation for "bloody mindedness" of the British Leyland workforce -a reputation constructed through Press and TV coverage of industrial disputes. This in turn enables the Metro to function contradictorily in the news media both as a symbol of "Britain's hope" and as a symptom of the "British disease" (where production hold-ups and technical faults are cited as evidence of Britain's decline as an industrial power which, to complete the circle, is "explained" by reference to the "problem" of the British workforce). The entire history of British Leyland labour relations is reified in the Mini Metro's public image. The advertising campaign mobilises that history (the memory of strikes hovers just behind the copy just as in the Hovis television ads, the memory of the Depression looms out of the conjunction of sound and image - the melancholy strains of a Northern brass band, the black and white image of "noble" cloth-capped workers). The Mini Metro advertising campaign overlays two forms of patriotic optimism -that Britain can

make it, that British Leyland can go on making it (and supplying the spares) across the more generalised faith in the future which purchasing a new car normally implies. The potential purchaser is invited to make all three investments simultaneously -in the future of Britain, in the future of British Leyland, and in his or her own personal future. And newspaper reports make it clear that whenever a dispute threatens production of the Metro, then all three investments are endangered. In this way every reader's stake (as a taxpayer) in the British Leyland Motor Company is realised in the image of the Metro (the car for little people), in the image of the Metro in jeopardy and a number of parallel interpellations become possible: "you" the reader/taxpayer/consumer/car-owner/Briton/ patriot/non-striker. The place of the Mini Metro in the present scheme of things is thus defined by a double address in time -back to British Leyland's past and forward towards a dream of trouble-free consumption, a purified economy and a disciplined, docile working class... (Hebdige,1988:)

[43] The broad theoretical appropriation of modern, postmodern and feminist discourses in the recent work of Henry Giroux is a similar kind of unification which possibly provides a reasonable answer to Johnson's quest for an interdisciplinary and theoretically diverse approach to cultural studies. It appears that Giroux himself is not unaware of Johnson's analytic approach to cultural products. The reason making me think so is that Giroux (1992) advances a similar cultural circuit (which he calls "circle of power") when he speaks specifically about cultural politics and education. For Giroux there are also four major points in the circle which begins to develop when we enlarge our notion of how ideology works:

First, obviously there's a *material* [production] apparatus at work in the state, in textbook companies, in banks, etc. Second, there is the question of *text*. Who authorises them, who produces them, what is the historical weight of the range of meanings they make available or legitimise? And texts include everything from visual images to curricula. Third, there is the question of *ideology*. What ideologies and lived experiences enter the context of a particular classroom? Finally, there are *communities*. One should examine communities to understand how ideologies accumulate historical weight for kids, how they provide the conditions for specific intellectual and emotional investments. Beyond addressing the ideologies that kids bring to the classroom, I'm concerned with the historical, social, and political conditions that create lived experiences for those kids in the first place (Giroux, 1992:154, emphasis added).

If we try to represent these ideas with a diagram we get a pattern very similar to that of Johnson's circuit:



The similarity of the models reveals the common interest of both theorists in the field and their common influence by earlier explorations in cultural theory. Or it might simply be an appropriation of Johnson's work by Giroux without enough tribute to the first. Whatever the case, both theorists point to the centrality of a number of issues: first, they indicate the importance of the analysis of the material production of cultural products; second, they point to the inadequacy of structuralist textual analysis alone to account for the complexity of cultural phenomena. The deconstruction of the form of the text or event itself is only one limited aspect of the analysis of the ideological process; third, they recognise the complexity of audiences and of the construction of subjectivity; fourth, they recognise that the audience's experience and appropriation of cultural products provides conditions for the transformation of their lived experience. In general, Giroux's theoretical appropriations of other discourses in social and cultural theory can be seen as complementing/extending Johnson's analysis and as providing some of the "pointers to further transformations" which Johnson was looking for in his 1986 paper. As far as analysis of educational practice is concerned, these appropriations allow for the enrichment of the basic model in a sense that it becomes a more adequate tool for an understanding of the complexity of influences and determinations.

[44] *Channel One*, is a commercial, business-led technology which has recently invaded American classrooms. It is a commercially produced television news programme that is broadcast to thousands of schools in the United States comprising ten minutes of international and national news and two minutes of commercials produced by Whittle Communications. For analyses of the implications of the presence of Channel One in US classrooms see also Barry (1991), Hoffman (1991) and (de Vaney, 1991).

[45] Apple's discussion is more of a conceptual prospectus for a thorough study of *Channel One* (in fact of any other similar technological product), rather than a report of a thorough study itself.

[46] Agalianos (1992). The main findings from the dissertation are reported in Agalianos & Cope (1994).

[47] See Appendix B for more details about the interviewees.

[48] See, for example, Goldberg (1991).

[49] Robert (Bob) Lawler, together with Seymour Papert and Nicholas Negreponte, was significantly involved in the functions of the Paris-based *Centre Mondial L' Informatique et Resources Humaine* (see Appendix Four). Today Bob Lawler is professor of education and computing at Purdue University.

[50] Cynthia Solomon, formerly vice-president of *Logo Computer Systems Inc.* (which will be referred to in Chapter Seven), participated in the development of Apple Logo. She holds a doctorate in education from Harvard University.

[51] J.C.R. Licklider was professor of computer science and engineering at MIT. In the early 1960s, as director of the Information Processing Techniques Office in the Advanced Research projects Agency of the Department of Defence, he was instrumental in envisioning and funding the development of time-shared computers and advanced research in artificial intelligence and computer science.

[52] For a longer discussion of BBN's history and culture see Noble (1991), chapter 7.

[53] The U.S. Office of Education at the time had begun to provide substantial funding for research in science and maths education, following the lead of the National Science Foundation's science and curriculum projects in the immediate post-Sputnik period.

[54] The mathematical and educational issues that gave rise to Logo are discussed in Feurzeig & Papert (1968). The original Logo language is described in Feurzeig (1969). The use of the language in elementary and junior high school teaching in 1968-69 is documented in Feurzeig et. al. (1969).

[55] Hanscom Air Force Base outside Boston was a principal site for military research and development in computer-based air defense.

[56] REVERSE is a non-numerical procedure for reversing the order of the letters in a word (i.e. writing it backwards). An example in original Logo is:

```
TO REVERSE /WORD/
1 TEST IS COUNT OF /WORD/ 1
2 IF TRUE OUTPUT /WORD/
3 MAKE "NEW WORD" BUTLAST OF /WORD/
4 OUTPUT WORD OF LAST OF/ WORD/ AND REVERSE OF /NEW WORD/
END
```

To use REVERSE we write:

```
PRINT REVERSE OF "ELEPHANT"
TNAHPELE
```

(Example taken from Feurzeig et al, 1969:26)

[57] Education Development Center, Inc. (EDC) is a publicly supported nonprofit organisation dedicated to promoting human development through education. Through a wide range of projects, EDC works to address educational, health, and social problems and improve the quality of life for people of all ages and from all racial, ethnic, and cultural backgrounds. EDC was founded in 1958 when a group of scientists at the Massachusetts Institute of Technology joined forces with teachers and technical specialists to develop *PSSC Physics*, a high school physics curriculum that became widely used throughout the United States. Today EDC's staff of more than 300 people work on over 150 projects throughout the United States and in 20 developing countries.

[58] See discussion in Appendix Four.

[59] Marvin Minsky and John McCarthy had co-founded the MIT Artificial Intelligence laboratory.

[60] For more details on Jeanne Bamberger's work on Logo music see Bamberger (1982).

[61] Every button on the button-box corresponded to a Logo command (e.g. FORWARD, TURN, etc.) and by pressing a sequence of buttons young children could make a program which could then extend. With the slot machine, children could create a sequence of steps by placing cards sequentially into the slots instead of pressing buttons. The nature of the cards was read by the box and one could thus create a program.

[62] That is functions that could be used as objects, as lists, as numbers, etc. A very common and powerful technique in mathematics is to take a function and use it as an object in some other context.

[63] In fact, Harvey himself does not introduce the "turtle" until chapter 7 of his book (Harvey, 1985).

CHAPTER SIX

[64] About the same principles, see also Tempel (1995).

[65] In his discussion of policy texts, Ball (1990b) makes a useful distinction between "readerly" and "writerly" texts appropriating Roland Barthes. According to Ball (1990b:11), in a "readerly" text, the signifier/signified relationship is clear and inescapable and, therefore, there is the minimum of opportunity for creative interpretation by the reader: a "readerly" text makes the reader idle or redundant, "left with no more than the poor freedom to accept or reject the text" (Hawkes, 1977:113, quoted by Ball, 1990b:11). By contrast, "writerly" texts

> ...self-consciously invite the reader to 'join-in', to co-operate and co-author... to feel a sense of 'ownership'.

In this sense, Logo was intended by its users to be a writerly kind of text whereby the reader/user can have a high degree of flexibility, personal appropriation and input. Moreover -as I will demonstrate empirically in Chapters Six, Seven and Nine- Logo as a "text" is capable of more than only one interpretation; it may be appropriated by different groups and/or individuals in different ways, appropriation depending also upon the possibilities and the limits of particular contexts and settings of use.

[66] For a definition and extended discussion of "progressive education" and neo-progressivism in the USA and in Britain, see Cuban (1993) (especially chapters 6 and 7) and Darling (1994) respectively. See also the following: "Plowden- 30 years after an education revolution", *The Times Education Supplement* , 24 January 1997.

[67] Although the label "neo-progressive" is crude, it is useful here to place the visions of Logo developers in some tradition, if for no other reason than to suggest what separates them from other more technocratic visions that advocated the computer as an intelligent tutor or as a stand-alone electronic drillmaster. Placing them in this tradition will also help to suggest why

neo-progressive visions have had a hard time surviving in schools as they are currently organised (chapters Eight and Nine).

[68] In the *collection* type, says Bernstein, the contents of the curriculum stand in closed relation to each other, that is the contents are clearly bounded and insulated from each other. While in the *integrated* type the various contents do not go their own separate ways, but they stand in an open relation to each other, there is reduced insulation between contents. By "classification" Bernstein (1977:88) refers to "the degree of boundary maintenance between curriculum contents: where classification is strong, contents are well insulated from each other by strong boundaries; where classification is weak, there is reduced insulation between contents for the boundaries between contents are weak or blurred. By "frame" Bernstein refers to "the form of the *context* in which knowledge is transmitted and received. He refers to the specific pedagogical relationship of teacher and taught. For Bernstein, frame does not refer to the contents of the pedagogy but refers to the strength of the boundary between what may be transmitted and what may not be transmitted, in the pedagogical relationship:

> Frame refers us to the range of options available to teacher and taught in the *control* of what is transmitted and received in the context of the pedagogical relationship. Strong framing entails reduced options; weak framing entails a range of options. *Thus frame refers to the degree of control teacher and pupil possess over the selection, organization, pacing and timing of the knowledge transmitted and received in the pedagogical relationship* (Bernstein, 1977:89).

CHAPTER SEVEN

[69] A sprite is a hardware implementation of a turtle, to allow multiple moving objects on the screen.

[70] The MEP ran only in England, Wales and Northern Ireland: Scotland had its own programme, the Scottish Microelectronics Development Programme (SMDP).

[71] Research evidence suggests that the same was happening in the US as a result of the fact that Logo was never copyrighted:

> You see Logo itself was never copyrighted, patented. When it was invented it as all with public funds in this country and it was never patented, so they could never say: 'You can't make Logo unless we tell you what it is'. Anybody could make something and call it "Logo". In fact, there were times when there were different companies putting up things called "Logo" that weren't Logo. These different things could call themselves Logo and nobody could say 'You can't use that name (Dan & Molly Watt, interview).

[72] For an interesting chronology of Logo and turtle graphics see Appendix Six.

[73] Microworlds Project Builder is a dialect of Logo which has some object-oriented structures and some aspects of direct manipulation -turtles can be picked up and moved and can speak to each other. It has simple interface features, buttons and sliders, which prove rather transparent ways to help students control their own projects -pressing a button can run a command or a procedure and moving a slider can change a variable.

CHAPTER EIGHT

[74] Scottish education had its own equivalent of the Plowden Report, *The Primary Memorandum*, which appeared two years earlier in 1965.

[75] During the 1970s Molly Watt had a position on the faculty of the Educational Foundations Masters Program for experienced, practicing teachers at Antioch New England Graduate School of Education in Keene, New Hampshire.

[76] The Brookline Logo Project was a research project conducted by the MIT Logo group and the Brookline, Massachusetts Public Schools (Watt, 1979). For more about the project see Appendix Five.

[77] The considerations concerning the construction of the possibilities for the attack on progressivism are familiar from the literature (CCCS, 1981; Education Group II, 1991; Dale, 1979a; Shor, 1986; Dadds, 1992; Darling, 1994) whereby explanations are provided of the complex conjuncture of the historical development of social relations which led to these possibilities in the first place.

CHAPTER NINE

[78] This is not the real name of the school.

[79] This is not the real name of the school.

[80] An excerpt from my fieldnotes from this school reads:

Monday 12 Dec.

After the register, the girls are brought to the computer room which is next to the staffroom on first floor. The teacher is already in the computer room trying laboriously to switch the computers on and make them work. There are 13 computers (twelve Apple LC and one Apple Classic) for 26 girls (some girls are absent today). Three of the computers are not in working condition.

The girls are asked to form a long line in the corridor before they are allowed to the computer room. When they are allowed in they are not allowed to touch anything before the teacher gives them a short introduction. It is their second of the three Logo-weeks. In the first week the girls were taught basic Logo commands and worked with Pip machines. Today the task is to "allow the girls to explore" and draw lines/shapes on the screen using the basic commands FD, BK, LT, RT, PU, PD, CS, etc.

9:30. Most of the girls are not interested at all. They are very noisy and they don't have any sense of purpose or plan in whatever they are doing. Most of the girls keep talking about other things and two girls are playing with their travelcards, etc. A group of three are trying to draw a square. My impression is that they find what they are doing very boring and meaningless. When I ask them to tell me what they think about Logo they all say that Logo is something to draw shapes and lines with.

Monday 9 January
30 girls in the same class, third (and last) week of Logo-work. The teacher assigns the tasks of drawing name initials, rectangles and polygons. She also encourages children to put into the computer programs that have already done at home on paper during the holiday (only few children have done something).

Some of the computers are not working again today and 3 or 4 girls have to share. Most of the girls are not interested at all. Some are chatting about the forthcoming holidays, others are singing and laughing. Mary and Kate started with a clear task in mind and drew a pattern easily -they tell me they have done it before. Clara, Lioba and Beatrice are drawing a house with a door, windows and chimney. The teacher circulates photocopies of a sheet with basic Logo commands. A lot of noise, irrelevant play and laughs. Most girls clearly are not interested at all. Another group of three girls are playing away from the screen and after 45 minutes have produced a square (which they very well knew how to do) to show the teacher that they have done something. The assumption is that Logo is for drawing shapes. Jenny, Elizabeth and Susan play with coins. Afia likes Logo because she thinks it is "a thing to draw shapes with" and she likes drawing shapes. Shara says she likes it but not very much, Clare doesn't like Logo. All girls are relieved when the bell rings.

The teacher complains about the bad conditions teachers have to work under: more than 30 kids in a class, no technical support, etc. **Their work is organised in 3-week topics. Now she has finished Logo and it is likely that she will do something again in summer term. The girls will do Logo again next year (for another 3 weeks) but "this time it will be more organised, advanced and focused."**

[81] Mitchell Resnick is assistant professor of media arts and sciences at MIT, and Head of the Learning and Common Sense section of the MIT Media Laboratory. His current research focuses on how new technological tools can support and encourage new ways of thinking.

He is particularly interested in how people think about self-organising systems and emergent phenomena.

[82] Individual teachers are members of social systems (schools) that have shared senses of meaning:

> Dynamic conservatism is by no means always attributable to the stupidity of individuals within social systems, although their stupidity is frequently invoked by those seeking to introduce change... The power of social systems over individuals becomes understandable, I think, only if we see that social systems provide... a framework of theory, values, and related technology which enables individuals to make sense of their lives. Threats to the social system threaten this framework (Marris, 1975:51, quoted in Fullan, 1991:32).

The 'teachers' fault' view is totally lacking in explanatory power. Noss (1993:405) makes the same point arguing that whatever the state of Logo in schools, it is not helpful to claim -as it is currently fashionable- that it is all the fault of teachers.

[83] The majority of the books that started appearing in the market as Logo textbooks for teachers were written by people who were not familiar with the "Logo culture" and were encouraging a trivial and shallow adoption. As a response to the lack of appropriate books about Logo that teachers could use as sources for learning about it beyond a first introductory level, an effort was made by those members of the MIT Logo Group who were working most closely with teachers (or have had a teaching background themselves) to provide teachers with a series of books suitable for a deeper understanding of Logo. The outcome of this effort was a series of books dedicated to specific areas of application like Mathematics, Art and Language. A number of collections of "Logo activities" were also intended to give teachers a taste of what one could do with the language in the different school domains. One of the main ideas behind those collections had been the idea of moving away from programming as an end in itself, the idea of moving away from simply learning the commands of the language without having a particular project in mind, and the use of the language as a tool for learning within and across specific areas.

However, it was felt among Logo's developers that much more than a series of books was needed if Logo was going to be sustained as an innovation. Members of the Group undertook the task of introducing as many school teachers as possible into an appropriate "Logo culture", hoping that these teachers would become a yeasty fillment which would spread "appropriate" use of Logo at their schools:

> So there was an agenda that we should be doing something in the policy but no culture to support it... We felt that what was needed was the immersion of school teachers in an appropriate Logo culture through which they would get a deeper understanding of the Logo approach to teaching and learning (Molly Watt, interview).

With the zeal of missionaries Logo trainers started traveling across and beyond the country organising seminars, workshops and informal summer courses for teachers. Daniel and Molly Watt became central to this mission:

We introduced hundreds and hundreds and hundreds and hundreds of teachers to Logo. We did a lot of all-day workshops throughout the country and throughout Canada during that time. We traveled about once a month to do workshops for school systems... and there were some other people like us... [some teachers] were calling us 'Mr. and Mrs. Logo' (Watt & Watt, interview).

Through these activities a large number of teachers were introduced to Logo, they were encouraged to take Logo back to their classrooms and to keep in touch with each other sharing a sense of community; this was the main way in which Logo was spread at US schools. As an extension of the effort to create an appropriate "Logo culture" among teachers, the "Logo Action Research Collaborative" was established as an attempt to support teachers in deepening their understanding by studying and learning in their own teaching and in becoming the authorities on what their students were learning through this process (Watt & Watt, 1993).

The effort of Logo's developers to develop books, materials and teacher training were attempts to develop elements of the infrastructure which was thought as necessary to sustain Logo as an innovation. However, only a small part -if at all- of the infrastructure required had been built prior to implementation. Excited by the fact that micros were being introduced into schools and seeing their vision coming closer to reality, the Logo Group didn't take into adequate account some of the realities of mainstream schools and particularly the mechanisms of institutional and organisational reaction that would resist an innovation like Logo which was incompatible with the dominant educational structures and practices at a time of transition.

[84] I have argued in Chapter Three that, rather than starting with a determination of what they wanted schooling to accomplish and then examine how technology might be used to achieve those goals, those "computer literacy" initiatives were unfortunately based on the attitude "this technology exists, we 've got to have it"; educational computing has largely been technology-driven rather than curriculum driven. As a result, putting computers in schools has meant getting more of the same, only automated now. And assessments of whether newly purchased technologies are living up to expectations are equally rare, also reducing the likelihood of computers contributing to meaningful educational improvements.

In this case, as in many others, there is an *a priori* presumption that the addition of new technologies brings automatic benefits. Whereas other innovations -the use of paid consultants, for instance- are routinely planned with attention to the subtle hazards of vested interests, mixed motivations, unforeseen effects, and the like, the special status of computer technology -and the enormous interests behind it- rendered it immune from such considerations. The prospect of "more technology for schools" was at the time self-evidently desirable, and efforts to raise questions -even merely saying 'use the same judgment here you would in any other situation'- were perceived as anti-technology statements. Because of the presumption of technology's largess, skepticism appeared simply irrational and was therefore dismissed without consideration. In such an ideological context -dominant in both the US and the UK in the early 1980s- a serious examination of what social visions were built into -and in turn enacted by- Logo became very difficult, almost impossible.

[85] For a discussion of the Black Paper years see Darling, 1994, chapter 9.

[86] Upon the introduction of Logo into the National Curriculum teachers were forced to consistently casting Logo in a framework that favours the maintenance of the status quo. They were driven to think of Logo as helping schools in their task of teaching an existing curriculum in classrooms instead of confronting the fact that Logo puts the very idea of school into question. It is worth noting once again that this orientation differs dramatically from that of many of Logo's developers, who -as I have discussed in Chapters Five and Six- saw Logo usage as a vehicle for radically transforming education. This emphasis on how Logo fits into the current curriculum is hardly surprising since teachers are, in fact, held responsible for covering certain material in their classes. Thus, innovations like Logo are likely to be judged on the basis of what they can contribute to the attainment of this goal. This is, in fact, what happened when Logo was introduced into the National Curriculum in England and Wales, according to which Logo should be used in conjunction with specific attainment targets in Maths. In the 1991 "National Curriculum", Logo appeared rather strangely in two "Statements of Attainment":

Target	**Statement of Attainment**	**Example**
AT 1/4: Using and applying maths	Identify and obtain information necessary to solve problems	When trying to draw repeating patterns of different sizes using LOGO, realise the need for a procedure to incorporate a variable, and request and interpret instructions for doing this.
AT 3/3: Algebra	Use inverse operation in a simple context	Use doubling and halving, adding and subtracting, and FORWARD and BACWARD (in LOGO) etc., as inverse operations.

From Mathematics in the National Curriculum, 1991.

These "statements" and "examples" have been subject to several revisions which I have not thought it worthwhile to track. In fact, they were soon to be replaced by the 1995 version where Logo is not mentioned at all.

CHAPTER TEN

[87] Rather than viewing user behaviour as a single expression of the will of producers, or of already existing (and seemingly immutable) social divisions, "consumption" of Logo in this perspective can be conceived of as "production" in its own right. Because it leaves neither the person engaged in it, the object involved, nor the sphere of production untouched. The meanings attached to -or encoded into- an object like Logo in the act of its initial production are never automatically folded into the life of those at whom it is aimed. Meaning is also produced by users (of Logo) through the use to which they put this object in the practice of their everyday lives. So -as I have argued in Chapter Nine- while the "elements" used may be determined in the sphere of production, how those are used -to what ends and with what effects- cannot be so easily pre-established.

[88] However, Turkle's approach is less useful in that it perpetuates the notion that technologies have no meaning in themselves, ignoring the intent behind their development and the embodiment of this intent in the material technology; and her analysis could be extended by viewing the user as socially constructed, rather as some kind of free-floating individual.

[89] See, for example, European Commission (1997), De Laet *et al.*(1996), European Commission (1996).

APPENDIX THREE

[90] An interesting review of this collection is provided in Harris (1992), chapter 3.

[91] For an interesting critique of Bourdieu's work on consumption see duGay et.al. (1997), chapter 5.

APPENDIX FOUR

[92] The salaries were far greater than the French academic salaries and the team was spending a very large amount of money. Finally the case wound up in the French Accountancy Courts as a scandal.

[93] Former director of Computers and Communications at MIT.

APPENDIX FIVE

[94] The computer programming necessary to work with Logo was extensive and large computer memories were required to contain it. At the time, such memory capacity was available only via large, expensive and non-portable laboratory computers.

[95] For an extensive discussion and evaluation of the Brookline Logo Project and other Logo research projects see Watt (1982:116-134).

[96] Dan Watt holds a doctorate in engineering from Cornell University and he is a former elementary-school teacher. He was involved in the Brookline Logo project at MIT and for a number of years he has been an editor with BYTE Books. Currently he works at the Education Development Center in Newton, Mass. where he is involved in curriculum development.

[97] All the three reports published about the Brookline project were optimistic in tone. An introductory Report I (which was added last in spring 1980) provided unfamiliar readers with a context for understanding the research reported in Parts II and III. It included a discussion of Logo's educational and computation-theoretical perspectives and of other related work in Europe, in Canada and in the US. The second part of the report included: an overview of the Brookline Logo project; a description of the learning styles of different students who took part in the project; the experiences of students at both extremes of the range of abilities present in a typical public school; a breakdown of the computer programming skills and concepts learned by the students during the course of the project; a breakdown of the mathematical and geometrical skills and concepts learned by the students during the course of the project; a description of the results of a brief exposure of students to a dynamic turtle which simulates Newtonian motion. Part III of the report presented sixteen separate student profiles describing the Logo experiences of each student in some detail. Each profile includes a statement of how the child is perceived as

a student in the regular academic areas of the school, a description of "what the child learned" in the Logo classes, an analysis of each child's particular strengths and problems, and the particular teaching strategies that were considered appropriate for each child.

[98] The method Pea & Kurland followed was that of comparing two experimental and two control groups. In one experimental group the children were aged between eight and nine, in the other they were eleven and twelve. Each group was mixed sex and had twenty-five children. Pea & Kurland studied three aspects of the children's abilities in the experimental group after a year's exposure to Logo: the level of programming expertise that children had developed; the depth of their understanding of programming concepts such as recursion; the development of general planning skills which had been spontaneously transferred beyond programming. In testing them on transfer of planning and other problem-solving skills, the researchers found no significant difference and concluded that their results do not support the hypothesis that learning to program in Logo teaches problem-solving skills that can transfer to other problem solving domains.

[99] Apart from the Logo projects charted in this section, there have been a number of other US schools sites where Logo has been used for research and development in the late 1970s and early 1980s. The Cotting School for the physically handicapped in Boston has been the site of a series of projects conducted by Dr. Sylvia Weir of MIT. In these projects Logo has been used with cerebral palsy students previously unable to communicate effectively (Weir, 1987). For Watt (1982:132), of all the Logo projects, this has been the most dramatic in demonstrating Logo's effectiveness for students who previously had not been successful in academic settings. Logo projects with children with special needs were initiated by Paul Goldenberg and continued by Sylvia Weir.

APPENDIX SIX

[100] This chronology was kindly sent to me by Mike Doyle, chair of BLUG.

APPENDIX NINE

[101] For an interesting discussion see Noss & Hoyles (1996).

[102] Qualitative and quantitative empirical research has been produced on several facets of Logo programming by (especially elementary) students. This Logo research literature suggested a focus of research interests in three main directions:

- the direction of curriculum development (some super new procedures, programs, projects that will change the world if only people would use them);
- the direction of professional development (this is how best to teach teachers to do it);
- the direction of classroom research (ethnographic at best, and at its worst some mindless comparison of groups of children treated with more or less doses of Logo).

Some studies report positive results and claim to have found positive effects of learning to program in Logo with children improving their intellectual skills: Clements & Gullo (1984), Clements (1986, 1987), Reiber (1987). Clements & Gullo at Kent State University reported that certain cognitive and metacognitive skills developed significantly better in a group of children who worked with Logo for 12 weeks. Clements (1985), assessing the results of 40 early Logo studies asserted that the results, although not conclusive, indicated that "Logo does appear to offer significant educational advantages". A small number of Logo studies have been more descriptive, tending to involve small numbers of students and to give more background about the learning context, the specific teaching objectives, and the methods used in particular settings. These studies tend to focus on students' learning in some detail, and while they show that Logo-using students do engage in mathematical problem-solving behaviours, they also reveal specific difficulties students experience in using Logo effectively (Papert et al 1979; D. Watt, 1979a; Leron 1983, 1985; Hillel, 1984; Hillel & Samurcay, 1985; Hoyles, 1985; Kull, 1985; Noss, 1985; M. Watt 1986; Weir 1987). A number of Logo studies have also focused on specific teaching strategies and interventions (Kinzer et al, 1985; Klahr & Carver, 1987). A number of observers have commented on the importance of the Logo teachers' role (Leron, 1983, 1985; Moursund, 1983; Watt & Watt 1986) and only a handful of research papers focused directly on teachers' role in supporting Logo learning (Burnett & Higginson, 1984; Hawkins, 1985; Carmichael et al 1986; Stavely et al, 1986; Watt et al, 1986).

[103] One restoration voice who spoke this conservative ideological language of 'quality' against 'equality' was Robert Ebel who in 1978 saw ruins all around education, thanks to egalitarianism:

Ebel was speaking to an audience at the Educational Testing Service (ETS), the organisation marketing the nation's most famous standard exam, the Scholastic Aptitude Test (SAT). He denounced the progressive pedagogy which tends to use fewer of the tests busily marketed by ETS. The testing business and the billion-dollar textbook industry certainly have a big stake in classroom pedagogy. They have a lot to lose if students and teachers write their own materials and do their own internal evaluations of learning. The huge dollar purchases of schools are one commercial dimension to the shape of curriculum. In the scope of a grand culture war, standard testing and mandated texts involve the dominance of official ideology, the construction of consciousness in each new generation of students, and the displacement of opposition voices. In supporting the restoration pedagogy of lectures, tests and texts, Ebel suggested two key conservative themes which echoed from one end of the restoration to the other: equality is in competition with excellence and the individual student and teacher are to blame for the current school decline. These conservative claims needed ample test scores to make them credible. If scores on traditional tests were lower, then obviously non-traditional students and non-traditional teaching [like Logo] were the culprits... In using test scores to indict egalitarianism and to support 'excellence', Ebel reversed the 1960s tendency to name the system as the source of school and social problems (Shor, 1986:8).

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